ALL ABOUT

THE "COCONUT PALM"

(*Cocos Nucifera.*)

TPL
STOCK VERIFIED
1995

INCLUDING

PRACTICAL INSTRUCTIONS

FOR

PLANTING AND CULTIVATION

WITH

Estimates specially Prepared for Expenditure and Receipts;

A

Special Chapter on Desiccating Coconut,

AND

OTHER SUITABLE INFORMATION

FROM A VARIETY OF SOURCES;

REFERRING TO THE INDUSTRY IN CEYLON, SOUTH INDIA, THE STRAITS SETTLEMENTS, QUEENSLAND, & THE WEST INDIES.

COMPILED BY

J. FERGUSON, C.M.G.,

Editor of the "*Ceylon Observer*" and "*Tropical Agriculturist.*"

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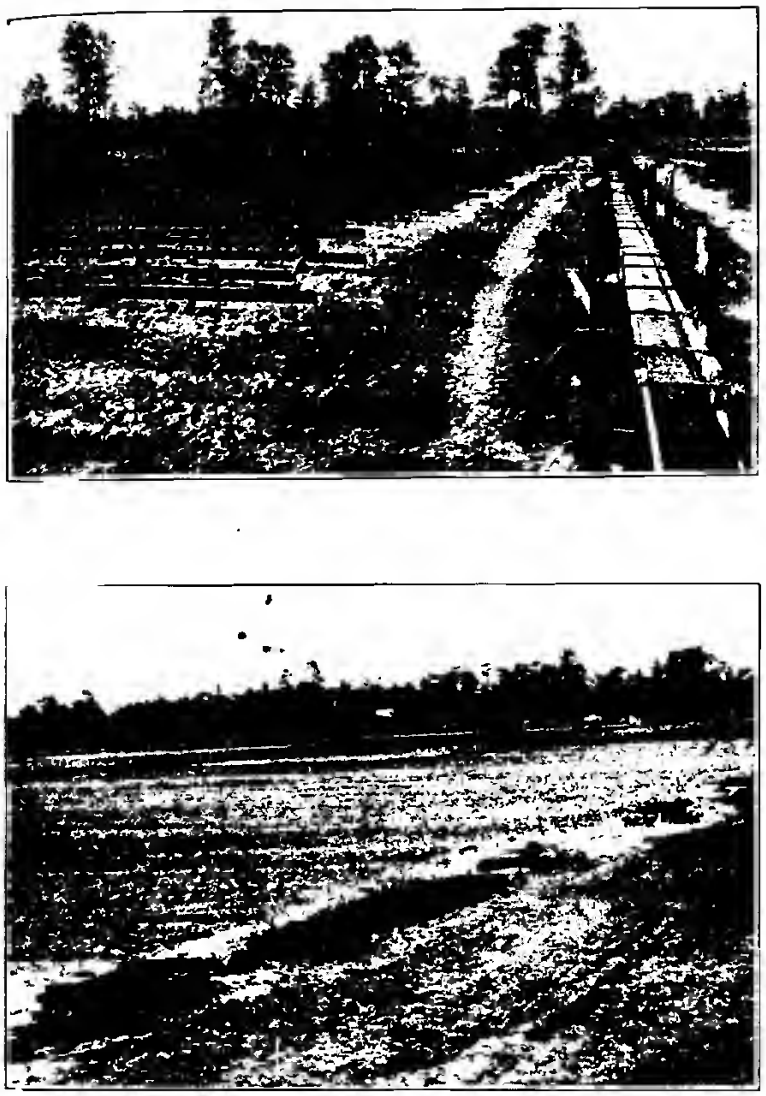

PLATE I. — IRRIGATION.

Top, wooden sluice for conducting water to cucumbers and other crops, with V-shaped troughs to carry the water and also to be used to protect plants from frost; bottom, sub-irrigation of celery field, showing head-boxes.

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PREFACE TO THE THIRD EDITION.

IN publishing a THIRD EDITION of our MANUAL ON THE COCONUT PALM—first issued in 1885—we have endeavoured to give prominence to what is of immediate service to the intending cultivator, and to relegate to an APPENDIX the fuller information compiled from various sources. But we must point out that while practical instruction for the Planter will be found at once on pages 32-47, he must not omit to notice the useful information from practical writers given on pages 48-63; and again ii to xiv and cxi-cxxiii. The Estimate of Expenditure and Receipts for a Plantation on pages 78-9 can be compared with another much more detailed on pages 80-86, which is more "up to date." We have as the penultimate chapter of this volume, a final contribution on the subject of Coconut Planting from one who is a patriarch among his brethren in this island, and whose shrewd commonsense is proverbial: we refer to Mr. W. B. Lamont. Finally, we are able, for the first time, to give a chapter on Desiccating Coconut from the pen of Mr. C. M. B. Wilkins.

The varied information respecting Coconut Cultivation in countries other than Ceylon, cannot fail to be useful; and we have specially to thank Mr. H. N. Ridley, Director of Botanic Gardens and Forests, Singapore, for permission to reprint his Report (and illustrations) on the destruction of Coconut Palms by Beetles—see pages cxxix to cxxxiv.

THE COMPILER.

JANUARY, 1904.

COCONUT PLANTER'S MANUAL.

THE BEGINNINGS OF COCONUT CULTIVATION IN CEYLON.

THE coconut palm is by no means indigenous to Ceylon. Though the most striking and ubiquitous of all plants over a great part of the lowcountry, the palm is nowhere found that its planting cannot be accounted for; and unlike the cinnamon bush, or rather tree, it can nowhere be discovered in a wild state. De Candolle, the greatest authority on the subject, places the original habitat of the coconut palm in the Eastern Archipelago, somewhere in the neighbourhood of Sumatra and Java, and surmises that nuts floated thence both East and West. Eastwards to the Islands of the Pacific and the coast of Central America, and Westward to Ceylon and the East Coast of Africa. The native tradition that locates the earliest specimen or grove of this palm in the neighbourhood of Weligama, on the Southern Coast, is in strict accordance with what might be expected under De Candolle's theory. The tradition is that a king of Ceylon was a leper, or afflicted with some skin disease, and that he (Kusta-Raja) was cured by sea-bathing and the milk of the coconut, or the use of the expressed oil. Curiously enough, the *Maháwaṇsa* (the ancient Sinhalese history of Ceylon) does not contain nearly so many references to the coconut as it does to the palmyra palm, although the latter now does not cover nearly the area occupied by coconut. One shrewd surmise why the *Maháwaṇsa* has so little to say about the coconut, hazarded by Mr. H. Nevill, is that the practice of toddy-drawing after a time, and its distillation into spirit, would prejudice the priestly historians against the palm and its cultivation. Be this as it may, Mr. Nevill notices that the *Maháwaṇsa* (XLII. chapter) records how King Aggrabódhi I. about A.D. 589 caused "a coconut plantation of three yojanas (about 36 English miles) in extent" to be formed, probably between Dondra and Weligama, and so it is surmised that his statue was cut out of the rock near the Weligama Vihara, as a memorial of the King who introduced coconut planting into Ceylon.

We are indebted for the next link in the chain of local coconut planting to the intelligent Atapattu Mudaliyar of the Colombo Kachcheri. Looking over his English copy of the *Maháwaṇsa*, Mudaliyar Solomon Seneviratne came on the passage where it is related that the Minister of Prákrama Báhu the Great formed a coconut plantation between Bentota and Kalutara, one yojana or 12 English miles in width. The original passage bearing on the planting is worth transcribing as follows:—

"Thence the great minister proceeded to the port of Bhimatittha. And there he built a bridge, eighty-six cubits' span, at the mouth of the Kálanadi* river; one of about one hundred yatthis'† span at the village Kadalisena; ‡ one of forty yatthis' span over the Salagama river § and one of fifty cubits' span over the Salapadapa river.‖ Thus did he build these and other bridges at divers places where it was difficult to cross over; and likewise also he made numerous gardens and halls for preaching and the like, and did even give away much alms and hold feasts (in connection therewith).

"Afterwards this great minister of the king formed a large coconut garden, full of fruit and fine shade, and gave it the famous name of Prákrama Báhu; and it extended from the Bhimatittha Vihara [Bentota] unto the ford of the Kálanadi [Kaluganga], a space of about one yojana in width.

"And when he had caused the great forest Mahalabujagaccha¶ to be cut down altogether and rooted up, he made a fine village thereon and planted a large grove of jak trees near it."

The Atapattu Mudaliyar, in calling our attention to the passage, writes:—

"It appears that coconut estates on a large scale were planted on the South-Western Coast of Ceylon long before the arrival of the Portuguese. See 44th verse of the 86th chapter. 'Bhima-tittha' is modern Bentota. 'Kalanadi' is the Kaluganga. The whole of the coast line from Kalutara to Bentota formed one coconut garden, and was named after the King who caused it to be planted.

"It is very interesting to find that the Sinhalese of that date had found the best soil in the Island for coconuts to plant the Royal

* The Black river, Kalu-ganga.
† A yatthi is equal to seven cubits of two spans to the cubit.
‡ Kehelsen, Kchel-lenava?
§ Salgamu-ganga.
‖ Salruk.
¶ Madelgasvanaya.

garden. It is possible, as you mentioned to me, that on the Southern part of the coast the coconut first grew from nuts washed ashore from the Eastern Archipelago."

The strange part is, if there were extensive coconut groves in the South-West part of the island before the advent of the Portuguese, that there is little or no mention of the coconut by the Portuguese historian Ribeiro or his French editor. The areka and talipot palms are freely mentioned; but the coconut scarcely at all. It is only after the arrival of the Dutch that we hear of a stimulus to the extension of coconut planting being afforded. But even then, it will take most people by surprise to learn that so late as A.D. 1740 the coast line between Colombo and Kalutara—now a continuous coconut grove—remained unplanted and was described as "nine-tenths waste," and so Governor Van Imhoff, in that year, proposed surveying and distributing this land in limited portions to "persons who are inclined to plant them with coconuts and to pay Government duties on them." So, by a system of "Rajakariya" right through, was all the coconut planting (as also all the tank building and canal digging) done in Ceylon previous to the advent of the British. And yet we have no hesitation in saying that the present century, and indeed, the past fifty years, have seen more than ten times the area covered with the coconut palm that can be credited to all the Kings or Governors in the twelve hundred and sixty years between A.D. 589 and 1840.

FURTHER REFERENCES TO THE COCONUT PALM IN THE "MAHAWANSA."

Besides the two references to the coconut palm which we have already mentioned, we find the following in the *Mahávaṇsa*, Parts I and II :—

(Chapter XXV, page 98).—During the battle between Dutugemunu and Elála (about 161 B.C.) Goṭha (one of the former's warriors) is said to have seized a coconut tree and Mahasóna (another warrior) a palmyra tree—with which they slaughtered the Damilas.

In Chapter LXXIV (page 214) the following passage occurs :—

"He (Prákrama Báhu—1164 to 1197 A.D.) also adorned both sides of the road with fruit-bearing trees, as the king-coconut, plantain, areca, coconut and such like; and with water jars filled with bunches of

beautiful flowers, and with many kinds of hanners and flags, and with lamps, censers and such like."

Then, in Chapter LXXXVI, page 294, we read that King Prákrama Báhu II. (1240 to 1275 A.D.) is said to have thought within himself saying:—"Great indeed his [Minister Devapatirája's] piety, for once he prayed that he might become a Buddha, and planted a coconut, having earnestly prayed and resolved (that some sign should he shown him that his desire would he fulfilled), and lo, there opened up three huds from the three eyes thereof." And the King ordered his Minister (among other things)—"At the Bhimatittha Vihara where the King Nissaṇka planted an orchard, do thou likewise, in my name, lay out a large garden full of coconut and other fruitful trees."—Of course this refers to the Bentota-Kalutara coconut plantation which has been already alluded to above.

In Chapter XCVII, page 335, we find the following reference:—"And this chief of men (Srí Víra Prákrama Narèndra Sinha—1701-1734 A.D.) formed a suburb named Kundasala, nigh unto the chief city, in the large coconut grove hard by the beautiful bank of the river," etc.

In Chapter C, page 347, Kirtí Srí Raja Sinha (1747-1780 A.D) is said to have honoured the Tooth-relic daily with (besides other things) green and yellow coconuts.

COCONUT PALM.

Cocos Nucifera, Linnæus.

(*From "Origin of Cultivated Plants," by Alphonse de Candolle, 1885.*)

The coconut palm is, perhaps, of all tropical trees, the one which yields the greatest variety of products. Its wood and fibres are utilized in various ways. The sap extracted from the inner part of the inflorescence yields a much-prized alcoholic drink. Tho shell of the nut forms a vessel, the milk of the half-ripe fruit is a pleasant drink, and the nut itself contains a great deal of oil. It is not surprising that so valuable a tree has been a good deal planted and transported. Besides, its dispersion is added by natural causes. The woody shell and fibrous envelope of the nut enable it to float in salt water without injury to the germ. Hence the possibility of its transportation to great distances by currents and its naturalization on coasts where the temperature is favourable. Unfortunately, this tree requires a warm, damp climate, such as exists only in the tropics,

or in exceptional localities just without them. Nor does it thrive at a distance from the sea.

The coconut abounds on the littoral of the warm regions of Asia, of the islands to the south of this continent, and in analogous regions of Africa and America; but it may be asserted that it dates in Brazil, the West Indies, and the west coast of Africa from an introduction which took place about three centuries ago. Piso and Marcgraf* seem to admit that the species is foreign to Brazil without saying so positively. De Martius,† who has published a very important work on the Palmaceæ, and has travelled through the provinces of Bahia, Pernambuco, and others, where the coconut abounds, does not say that it is wild. It was introduced into Guiana by missionaries.‡ Sloane§ says it is an exotic in the West Indies. An old author of the sixteenth century, Martyr, whom he quotes, speaks of its introduction. This probably took place a few years after the discovery of America, for Joseph Acosta|| saw the coconut palm at Porto Rico in the sixteenth century. De Martius says that the Portuguese introduced it on the coast of Guinea. Many travellers do not even mention it in this region, where it is apparently of no great importance. More common in Madagascar and on the east coast, it is not, however, named in several works on the plants of Zanzibar, the Seychelles, Mauritius, etc., perhaps because it is considered as cultivated in these parts.

Evidently the species is not of African origin, nor of the eastern part of tropical America. Eliminating these countries, there remain western tropical America, the islands of the Pacific, the Indian Archipelago, and the south of Asia, where the tree abounds with every appearance of being more or less wild and long established.

The Navigators Dampier and Vancouver¶ found it at the beginning of the seventeenth century, forming woods in the islands near Panama, not on the mainland, and in the isle of Cocos, situated at three hundred miles from the continent in the Pacific. At that time these islands were uninhabited. Later, the coconut palm was found on the western coast from Mexico to Peru, but usually authors

* Piso, *Brasil.*, p. 65; Marcgraf, p. 138.

† Martius, *Hist. Nat. Palmarum*, 3. vols. in folio: see vol. ii. p. 125.

‡ Aublet, *Guyane*, suppl., p. 102.

§ Sloane, *Jamaica*, ii. p. 9.

|| J. Acosta, *Hist. Nat. des Indes*, French trans, 1598, p. 178.

¶ Vafer, *Voyage de Dampier*, edit. 1705. p. 186; Vancouver, French edit., p. 325, quoted by de Martius, *Hist. Nat. Palmarum*, i. p.188.

do not say that it was wild, excepting Seeman,* however, who saw this palm both wild and cultivated on the Isthmus of Panama. According to Hernandez,† in the sixteenth century, the Mexicans called it *coyolli*, a word which does not seem to be native.

Oviedo‡ writing in 1526, in the first year of the conquest of Mexico, says that the coconut palm was abundant on the coast of the Pacific in the province of the Cacique Chiman, and he clearly describes the species. This does not prove the tree to be wild. In southern Asia, especially in the islands, the coconut is both wild and cultivated. The smaller the islands, and the lower and the more subject to the influence of the sea air, the more the coconut predominates and attracts the attention of travellers. Some take their name from the tree, among others two islands close to the Andamans and one near Sumatra.

The coconut occurring with every appearance of an ancient wild condition at once in Asia, and western America, the question of origin is obscure. Excellent authors have solved it differently. De Martius believes it to have been transported by currents from the islands situated to the west of Central America, into those of the Asiatic Archipelago. I formerly inclined to the same hypothesis,§ since admitted without question by Grisebach;‖ but the botanists of the seventeenth century often regarded the species as Asiatic, and Seemann,¶ after a careful examination, says he cannot come to a decision. I will give the reasons for and against each hypothesis.

In favour of an American origin, it may be said:—

1. The eleven other species of the genus Cocos are American, and all those which De Martius knew well are Brazilian,** Drude†† who has studied the Palmaceæ, has written a paper to show that each genus of this family is proper to the ancient or to the new world, excepting the genus Elæis, and even here he suspects a transport of

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* Seemann, *Bot. of Herald*, p. 204.

† Hernandez, *Thesaurus Mexic.*, p. 71. He attributes the same name p. 75. to the coconut palm of the Philippine Islands.

‡ Oviedo, Ramusio's trans., iii. p. 53.

§ A. de Candolle, *Geogr. Bot. Raisonnee* p, 976.

¶ Grisebach, *Vegetation de Erde*, pp. 11. 323.

‖ Seemann, *Flora Viticnsis*, p. 275.

** The coconut called Maldive belongs to the genus Lodoicea: *Coco mamillaris*, Blanco, of the Philippines is a variety of the cultivated *Cocos nucifera*.

†† Drude, in *Bot. Zeitung*, 1876, p. 801; and *Flora Brasiliensis*, fasc. 85, p. 405.

the *E. guineensis* from America into Africa, which is not at all probable. The force of this argument is somewhat diminished by the circumstance that *Cocos nucifera* is a tree which grows on the littoral and in damp places, while the other species live under different conditions frequently far from the sea and from rivers. Maritime plants, and those which grow in marshes or damp places, have commonly a more vast habitation than others of the same genus.

2. The trade winds of the Pacific, to the south and yet more to the north of the equator, drive floating bodies from America to Asia, a direction contrary to that of the general currents.* It is known, moreover, from the unexpected arrival of bottles containing papers on different coasts, that chance has much to do with these transports.

The arguments in favour of an Asiatic, or contrary to an American origin, are the following:—

1. A current between the third and fifth parallels, north latitude, flows from the islands of the Indian Archipelago to Panama.† To the north and south of this are currents which take the opposite direction, but they start from regions too cold for the coconut, and do not touch Central America, where it is supposed to have been long indigenous.

2. The inhabitants of the islands of Asia were far bolder navigators than the American Indians. It is very possible that canoes from the Asiatic Islands, containing a provision of coconuts, were thrown by tempests or false manœuvres on to the islands or the west coast of America. The converse is highly improbable.

3. The area for three centuries has been much vaster in Asia than in America, and the difference was yet more considerable before that epoch, for we know that the coconut has not long existed in the east of tropical America.

4. The inhabitants of the islands of Asia possess an immense number of varieties of the tree, which points to a very ancient cultivation. Blume, in his *Rumphia*, enumerates eighteen varieties in Java and the adjacent islands, and thirty-nine in the Philippines. Nothing similar has been observed in America.

5. The uses of the coconut are more varied and more habitual in Asia. The natives of America hardly utilize it except for the contents of the nut, from which they do not extract the oil.

* Stieler, *Hand Atlas*, edit. 1867, map 3.
† Stieler, *ibid*, map 9.

6. The common names, very numerous and original in Asia, as we shall presently see, are rare, and often of European origin in America.

7. It is not probable that the ancient Mexicans and inhabitants of Central America would have neglected to spread the coconut in several directions, had it existed among them from a very remote epoch. The trifling breadth of the Isthmus of Panama would have facilitated the transport from one coast to the other, and the species would soon have been established in the West Indies, at Guiana, etc., as it has become naturalized in Jamaica, Antigua,* and elsewhere, since the discovery of America.

8. If the coconut in America dated from a geological epoch more ancient than the pleiocene or even eocene deposits in Europe, it would probably have been found on both coasts, and the islands to the east and west equally.

9. We cannot find any ancient date of the existence of the coconut in America, but its presence in Asia three or four thousand years ago is proved by several Sanskrit names. Piddington in his index only quotes one *Narikela*. It is the most certain, since it recurs in modern Indian languages. Scholars count ten of these, which, according to their meaning, seem to apply to the species or its fruit † *Narikela* has passed with modification into Arabic and Persian. ‡ It is even found at Otahiti in the from *ari* or *haari*§ together with a Malay name.

10. The Malays have a name widely diffused in the archipelogo —*kâlapa, klâpa, klôpo*. At Sumatra and Nicobar we find the name *njior, nieor;* in the Philippines, *niog;* at Bali *niuh, njo:* at Tahiti, *niuh;* and in other islands, *nu, nidju, ni;* even at Madagascar, *wua-niu.*|| The Chinese have *ye*, or *ye-tsu* (the tree is *ye*). With the principal Sanskrit name this constitutes four different roots. which show an ancient existence in Asia. However, the uniformity of nomenclature in the archipelago as far as Tahiti and Madagascar indicates a transport by human agency since the existence of known langnages.

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* Grisebach, *Flora of Brit. W. Indies*, p. 552.

† Eugene Fournier has indicated to me, for instance, *dradapala* (with hard fruit), *palakecara* (with hairy fruit), *jalakajka* (water holder,) etc.

‡ Blume, *Rumphia*, iii. p. 82.

§ Forest, *De Plantis Esculentis*, p. 18; Nadeaud. *Enum. des Plantes de Taiti*, p. 41.

|| Blume, *ubi supra.*

The Chinese name means head of the king of Yue, referring to an absurd legend of which Dr. Bretschneider speaks.* This savant tells us that the first mention of the coconut occurs in a poem of the second century before Christ, but the most unmistakable descriptions are in works later than the ninth century of our era. It is true that the ancient writers scarcely knew the south of China, the only part of the empire where the coconut palm can live.

In spite of the Sanskrit names, the existence of the coconut in Ceylon, where it is well established on the coast, dates from an almost historical epoch. Near Point-de-Galle, Seemann tells us, may be seen carved upon a rock the figure of a native prince Kotah Raya, [Kusta Raja] to whom is attributed the discovery of the uses of the coconut, unknown before him; and the earliest chronicle of Ceylon, the *Mahawansa*, does not mention this tree, although it carefully reports the fruits imported by different. princes.† It is also noteworthy that the ancient Greeks and Egyptians only knew the coconut at a late epoch as an Indian curiosity. Apollonius of Tyana saw this palm in Hindustan, at the beginning of the Christian era.‡

From these facts the most ancient habitation in Asia would be in the Archipelago, rather than on the continent or in Ceylon and in America in the islands west of Panama. What are we to think of this varied and contradictory evidence? I formerly thought that the arguments in favour of Western America were the strongest. Now, with more information and greater experience in similar questions, I incline to the idea of an origin in the Indian Archipelago. The extension towards China, Ceylon, and India dates from not more than three thousand or four thousand years ago, but the transport by sea to the coasts of America and Africa took place perhaps in a more remote epoch, although posterior to those epochs when the geographical and physical conditions were different to those of our day.

PALM CULTIVATION IN CEYLON.

There are said to be over a thousand known species of palms, but of these the proportion found in Ceylon is very limited, only 10

* Bretschneider, *Study and Value*, etc. p. 24.
† See introductory remarks at the beginning of this Manual.—*Compiler.*
‡ Seemann, *Fl. Vitiensis*. p. 276; Pickering, *Chronol. Arrangement*, p. 428.

to 12 indigenous species, while perhaps 20 to 25 are found in the Botanic Gardens. We have native to Ceylon, however, those of most value for their economic products, pre-eminently the Coconut and Palmyra, the Jaggery or Kitul (*Caryota urens*), the Arecanut, and the Talipot palm. By far the most important to the people of Ceylon is the

Coconut (*Cocos nucifera*).

The coconut is by no means so often mentioned in the *Mahâvansa*, (the ancient Sinhalese history of Ceylon) as the palmyra, and no allusion whatever is made to it as an article of diet in any of its products, nor is it mentioned among fruit trees desirable of cultivation before 1153.* In the same way, although the areca and talipot palms are alluded to by Ribeyro and his French editor, there is little or no mention of the coconut, now the most prevalent of all and the mainstay of native agriculture. The Dutch gave a great stimulus to the cultivation of the coconut, for what is now the scene of one of the most continuous groves of the palm in the island—namely, between Colombo and Kalutara—was so lately as 1740 described as nine-tenths waste. Governor van Imhoff in that year proposed surveying and distributing this land in limited portions to "persons who are inclined to plant there with coconuts and to pay Government duties on them." The ordinary life of a coconut palm is said to be about 80 years, but there are trees along our western coast certainly over 120 years still bearing, and some coconut planters believe the coconut tree practically has no limit to its productive life if judiciously and liberally treated At the beginning of the present century, the Western and Southern coasts of Ceylon presented with, certain intervals, a fairly continuous grove of coconut palms, but it did not extend far inland (10 million coconut trees being the reckoning between Dondra Head and Kalpitiya), but Bertolacci pointed out the large field for an extension of planting on the North-West coast around Chilaw and Puttalam, and he mentions that the peninsula of Kalpitiya was in his own time within

* Mr. Nevill in his *Taprobanian* (see *T. A.* vol. 1885-6 page 865) notices that Aggrabodhi, nephew of King Mahanâga, in A D. 589 planted a coconut estate 3 yojanas in extent, probably between Dondra and Weligama, and that his statue was cut out of the rock near the Weligama Vihara as a memorial of the King who introduced coconut-planting into Ceylon. Another tradition is that the King was a leper (Kusta Raja) and and was cured by seabathing and the use of coconut oil. It is shrewdly surmised by Mr. Nevill that the reason why the coconut palm is so little refered to in the *Mahawânsa* may be, because of the innovation of toddy drawing and distillating of spirit later on, which would prejudice the priestly historians against this palm and its cultivation.

18 years changed from a barren unproductive soil to an expanse of the finest plantations of this palm, and splendid cultivation extends now (1903) all the way from Colombo via Negombo to Chilaw nearly. Little or no coconut oil was in the first quarter of this century exported from Ceylon to Europe.* To India between 1806 and 1813 there were annually sent about three millions of coconuts, 28,000 measures of oil, and 3,500 cwt. of copra, besides 20,000 cwt. of coir. The Arabs must have taught the Sinhalese how to prepare coir or cordage from the fibre of the coconut about the 13th or 14th century. The manufacture of coir (said to be best from unripe nuts) from the husk of the coconut acquired great importance in the time of the Dutch, as many as 3 million pounds—of cordage, chiefly—being supplied and exported principally to Batavia and the Cape of Good Hope. The port captains of Colombo and Galle were allowed to manufacture or sell on their own account; the former 600,000 lb. and the latter 500,000 lb. of coir cordage. In the early days of the British the manufacture fell off, the natives considering the work only fit for low castes; but at the present day it affords extensive employment to the inhabitants on the coast, especially in the South and West.

Systematic coco-palm cultivation by Colonists in Ceylon was first commenced in the Jaffna and Batticaloa† districts in 1841, and a vast amount of money has been lost over it from first to last, many of the plantations having passed out of the original proprietors' hands for a trifling percentage of their cost. In 1853, Mr. A. O.

* In 1820 Captain Boyd, an Aberdeen navigator, in command of an East Indian trader (the partner afterwards in the firm of Acland, Boyd & Co.), is said to have taken home the first cargo of coconut oil ever exported from Ceylon. There was, at that time, no market for this article in England, and when the cargo arrived home there was some difficulty in persuading any one to purchase it. At length some relatives of the captain, proprietors of a wool mill, reported on the fitness of the oil for lubricating purposes, and a sale was effected. In 1832 or 1833 Acland, Boyd & Co. established the first oil mill worked by steam, and the export trade in coconut oil then became a favourite mode of utilising the savings of civilians and military men. Master Attendant, then Capt., Steuart also took a cargo of coconut oil home about 1820, utilising plantain stems to fill up the interstices between the casks. Another account has it that Governor Sir R. Wilmot Horton established the first coconut-oil mills worked by steam power at Colombo and made the first shipment of oil on Government account to London and that Messrs. Acland, Boyd & Co. then bought the mills (St. Sebastian) and got out an engineer of their own, the late Mr. Rudd, Senr. In the Government Calendar for 1835, one entry in the Directory portion for Colombo is:—"The Steam Engine in the charge of Mr. H. Rudd." Some years after Messrs. Wilson & Archer started the Belmont (now Hultsdorf) mills, Mr. David Wilson's father having invented a process for separating the fat from the oleine of the coconut oil, so making it (coconut oil) to keep liquid in cold: this gave a great impetus to the trade.

† See *T. A.* vol. 1893-4; page 313.

Brodie, Assistant Agent at Puttalam, stated that there were nearly a million coconut trees in the district of Chilaw and Puttalam, and that the cultivation was rapidly extending. From 1810 to 1850 was the era of planting by Europeans; then came a blank of ten years, and then the natives began to extend to their cultivation, and in the Western and N.-W. Provinces especially they brought many thousands of acres of jungle under cultivation, more especially along the valley of the Mahaoya between Negombo* and Polgahawela, since 1866, and of later years in the Chilaw and Madampe districts of the North-Western Province; at Rajakadalnwa and beyond towards Puttalam the process of planting coconuts still goes on, and there are large reserves. This movement forty years ago was a consequence of the growing prosperity of the people through the money disseminated for rice and other supplies, for carting, artificers' work, &c., by the great coffee enterprise from 1850 onwards, and of the Government unlocking their low-country reserves of Crown land. The latest extensive development has been in the South Batticaloa district where nearly 5,000 acres are now planted.

The principal coconut-growing region in Ceylon extends in a belt along the North-Western, Western and Southern coasts of Ceylon, and in the Batticaloa district of the Eastern Province and the Jaffna Peninsula in the North. Of late years a great deal of land has been planted more inland in the Western and North-Western Province, more especially along the side of the railway line, where Government have sold extensive areas for this purpose, and as stated above throughout the Mahaoya valley, in the Kegalla and Kurunegala districts, &c. The coconut palm flourishes in the neighbourhood of Ratnapura and there ought to be considerable scope for further planting in the Sabaragamuwa district, only that it is generally too wet to allow of liberal fruit crops. The Kelani Valley tea planters have been wisely interplanting coconuts in their fields, one Veyangoda estate alone supplying 32,000 nuts, enough for nearly 1,000 acres of plants widely interspersed. The popular belief is that this palm will not do well beyond the sound of the sea waves or the human voice, but, as regards the former very fine groves are found in the Central Province, in the rich valley of Dumbara, around Gampola, Peradeniya, Kandy, and in Matale, and the

* The several industries in the products of the palm have developed in a remarkable way. There are now in the district at least two Oil-Mills with hydraulic machinery driven by steam power, besides a number of *chekoos* worked by cattle and hand, two desiccating factories and six or seven Coir Fibre mills.—*H. White, Negombo Administration Report for 1893.*

Government Agent for the Central Province returned a crop of 13¼ million nuts gathered in the Central Province in 1896 (14,348 acres with nearly 22 million nuts in 1902), ; and 4 million in the Province of Uva (5¼ in 1902). The coconut palm requires an average temperature of 80° and 70 inches annual rainfall, although in the Chilaw district it does with less: the best soil is the alluvial flats alongside large streams not too frequently or long flooded; second, a deep brown gravelly loam such as the Matale Valley has in perfection in many parts. At Badulla there is good coconut garden flourishing at 2,000 feet elevation; and coconut-planting goes on at Bibile and Medegama. On one estate in the Matale district, 90 acres coconut with coffee interspersed did excellently well for some years, and the palms are still flourishing. In Ambagamuwa there is a solitary coconut palm at 3,500 feet above sea-level, but it has never produced fruit. Of late years, a great many coconut palms have been planted in coffee and cacao land in the Dumbara Valley, Kelani Valley, and Kegalla generally, (25,000 acres altogether), Galagedara, Panwila, and Matale districts; and very large plantations opened in the Kurunegala district. Coconut planting has also been greatly extending in the Batticaloa district, more especially in the new Southern district of Akrapattu where 3,000 acres have been sold and 2,000 brought into cultivation; while 875 acres have been planted in Trincomalee district; in Puttalam, 14,000 acres planted in 14 years; in Chilaw, Pitigal Korale South having 55,000 acres under coconuts. Even in the North-Central Province a good deal of planting has been done in recent years, and Mr. Ievers estimated in 1888 that 1,500 acres were under the palm. We fear 500 acres have not been added in the past 14 years. In Jaffna 300 acres were planted in 1900 and the rail way should stimulate further planting. Mullaittivu district has 1,351 acres under coconuts getting nearly 5 million nuts in 1902.

The calculation up to 1860, was that there were 250,000 acres of coconut palms (belonging to native and European-owned plantations) in Ceylon, covered with twenty million full-grown trees; but considering the extension or planting chiefly by natives in the interval of 33 years, we raised the total in 1893 to 650,000 acres and in 1898 to 60 million trees on 700,000 acres; but now in 1903 we feel bound to revise this and give (in view of our calculations on another page) the total area at 650,000 acres with 52 million trees, notwithstanding the great extensions we have notified above. In our Directory only 200,000 acres are entered of regular coconut plantations. Natives

own 525,000 acres at least out of the total of 650,000 acres. There is scarcely a native land-owner or cultivator in the country who does not own a garden of palms, or other fruit trees, or vegetables besides his paddy-field. Our estimate is far below the figures given in the Government Blue Book for 1902, which, however, we feel sure, are ridiculously inaccurate, as regards acreage and crops in certain provinces. Here is a summary of that return :

AREA AND CROP OF COCONUTS IN 1902.

Province.	*Acres.*	*No. of nuts yielded.*	*Average per acre.* †	*No. of coconut trees at 80 to acre.* *
Western	344,078	... 336,318,000	... 977	... 27,526,240
Central	11,348	... 21,739,398	... 1,515	... 1,147,840
Northern	20,082	... 21,392,190	... 1,065	... 1,606,560
Southern	99,669	... 157,474,922	... 1,578	... 7,973,520
Eastern	33,100	... 121,551,556	... 3,672	.. 2,648,000
North-Western ...	302,869	... 1,302,598,780	.. 4,300	... 24,229,520
North-Central ...	1,940	... 990,550	... 510	... 155,200
Province of Uva...	3,500	... 5,250,000	... 1,500	... 280,000
„ Sabaragamuwa	33,600	... 58,190,000	... 1,730	... 2,688,000
Total	853,186	... 1,775,808,396	... 2,081	... 68,254,880

The total acreage and number of trees in the North-Western Province and the total yield given of nuts are too large; but it is when the extent in all the provinces is noted that the unreliableness of the figures is exposed: an average yield of 1,260 nuts per acre for the island is about what used to be the minimum estimate or say 1,500 nuts; while on plantations the crop is sometimes up to 4,000 per acre: on the other hand much of the native land is covered with worn-out or over-crowded trees bearing nothing. We cannot, however, accept more than 52 million as an approximate estimate of the number of coco-palms of all ages from the newly planted upwards, and we would reduce the acreage to 650,000 acres. We believe, further, that the number of coconuts produced in a good average season in Ceylon is not below one thousand millions, the greater portion being used for the food and drink of the people.

It requires about 40 full-grown nuts or a years's crop from an average good tree to make 1 gallon of oil, 12½ of which (say 500 nuts) go to a cwt. worth about R16. Copra requires from 170 to 200 nuts to the cwt. Desiccated coconut kernel for confectionery—3 nuts to 1 lb.—is a recent local manufacture of growing importance, (see our list of Mills for its preparation and the large export now over 16¼ million lb. per annum); and coconut butter has become a great industry in Germany. For 1,200,000 gallons of arrack consumed

* The Compiler is responsible for figures in these columns.

annually in Ceylon and 120,000 exported, 3,000 palm trees at 4 gallons per tree may suffice (Mr. Ellis got 5·94 gallons from some rich trees); but an enormous number of palms are devoted to sweet and even intoxicating toddy. Taking last year's (1902) return of Exports we work out trees as follows:—

Coconut oil	512,500 cwt.	= Nuts	256,250,000
Copra	374,800* ,,	= ,,	74,960,000
Desiccated	16,227,565 lb.	= ,,	49,000,000
Coconuts	No.	,,	12,589,000
(Poonac and Coir are got from Oil and Copra nuts)			
Arrack, and Baker's and Sweet Toddy, say		,,	1,500,000
		Total Nuts	394,299,000

or not nearly one-half of the coconut crop from Ceylon palms, apart from the trees not in bearing or past bearing. If we take 19 millions as yielding the above, 21 for local food,† and 12 for young and old palms, we get a total of 52 million Coconut palms of all ages and qualities in Ceylon.† [For many other interesting commercial particulars see our "Planters Molesworth or Note-book." For discussions as to superior value of Cochin oil, see *T. A.* page 597 vol. 1897-98. For proper spelling "Coconut" see *T. A.* page 473 vol. 1895-6.]

We quote as follows from a letter of "W. B. L." in December 1887:—

"I do not know the proportion of oil obtained from copra in the great manufactories: but I wrought chekkus for a dozen years, and always got three gallons of oil from 45 lb. At 9 lb. 3 oz. to the gallon this is 27 lb. 9 oz or 61·8 per cent. I cannot believe that the chekku can extract more oil from the same copra than the hydraulic press, from thoroughly ground material: but the chekku will only operate satisfactorily on corpa as dry as sun or fire heat can make it. If then a recent statement as to the outturn of the mills be correct, it indicates the average of superfluous moisture in commercial copra to be 8·5 per cent. supposing the chekku and mill machinery to be equally effective."

The Government Bluebook for 1902 reports 2,729 oil mills in the Island—native "chekkus" driven by bullocks, chiefly—divided as follows:—Western Province 845; North-Western 135; Southern

* In 1898 the export of copra was as much as 506,277 cwt. Highest price of copra was £33 10*s.* per ton, London spot price, May-June 1902.

† Say that there are 700,000 families in Ceylon, do they use 1 or 2 coconuts a day on an average? Let us take 1½ and we get 383,000,000 nuts requiring about 21 million trees as above and giving a total of 52 million trees.—See also page 777 (*et seq.*) *T. A.* 1892-3.

1,529; Eastern 50; * Northern 168: Central and North-Central and Uva 0; Sabaragamuwa 2. But the chief work in expressing oil is done in the great steam mills (8 reported) with hydraulic machinery at Colombo:—Hultsdorf, Grandpass, Kelaniganga, Mattakkuliya, Hunupitiya, Mills, &c., and at Negombo. Of Desiccating Mills there are 6 in the Western and 2 in the N.-W. Province. Coir fibre, yarn and mattings are also prepared at some of the mills, notably at Hultsdorf, Dematagoda and Grandpass.

To a Ceylonese coconut plantation proprietor belongs the credit of introducing irrigation for the coconut palm on an extensive scale as a full account given in the *T. A.*, vol. 1887-8, page 687 will show.

Of the earliest age at which the coconut palm can be brought into bearing under favourable circumstances in Ceylon, we have the following evidence from a practical planter:—"Of 200 plants I put down in May 1879, ten per cent are now (June 1886) in flower, and I have already gathered nuts from the most forward tree. It appears then, that, though coconuts are not suited to the views of those who think to make rapid fortunes, there is no undertaking in the colony, where so much can be got, for so little outlay, by those who have the patience to *wait*, and there is nothing so suitable for such of the people of the country as have a little capital to invest if they will

* In the Administration Report of the Government Agent for the Eastern Province for 1890 we read:—"Coconuts continue to be an important factor in the food supply, not only as being directly consumed in large numbers, but on account of the additions to the pecuniary resources derived from the sale of surplus, chiefly in the shape of copperah. The demand for land continues entirely in small blocks, by natives especially on the North road. The crops of manioc, yams, and vegetables taken off the land after it is first cleared, and for two or three years after, are also a material addition to the food supply, especially in such a year as we have just passed through. Mr. E. N. Atherton has favoured me with the following account of the application of European enterprise and capital to coconut cultivation in this district:—'Dr. Sortain was the first to open out his coconut estate, Tannamurai, five miles from town bordering the lake, in 1846. Simultaneously my father opened Kalmunai estate, opposite the obelisk, and subsequently sold it to his cousin, Meadows Taylor, the novelist, whose brothers, Selby and Granville Taylor, opened out Linsogoor and Hyderabad estates, the former for Gerald Balmain and the latter for their brother. Holderness opened out Easter Seatoun for Ouchterlony in 1847, I think, after which Cumming and Drummond opened Tuvaringe, Springfield, and Kaluthavala estates. Mylempavelli, on the 7th milepost, was opened by Doctor Galland. Santhivelly, Munro's, was opened by him in 1847, and Rockwood by Kidd in 1850. O'Grady opened out his present estates for Nicol, who was so disgusted that he sold them cheap to the former." For 1897, the A. G. reports over 2,000 acres sold for coconuts and 6,000 acres at Tirukovil to be disposed of in April 1898, altogether 30,000 acres suitable for coconuts have been surveyed. About 000 acres have been opened at Tirukovil.

only do it justice during its early years."* In the Rajakadalnwa district, estates in their 9th and 10th year have yielded over 1,200 nuts per acre. The use of Salt would be very beneficial to Coconut culture: see Pamphlet on Duty-free Salt for Agriculture, published 1897 at *Observer* Office; also page 256, vol. *T. A.* 1897-8.

Of the self-propagating power of the cocoanut, we had an interesting report in *Nature* (1890) from a traveller who found young cocoanuts growing on the margin of an out-of-the-way South Pacific island, and naturally concluded that they were nuts carried thither by the waves; but his letter drew forth an explanation from another correspondent who saw the nuts "planted" by the Commander of a passing ship. Nevertheless, cocoanuts were no doubt carried by the sea from their original habitat, the Eastern Archipelago, both eastward to the Pacific isles and America, and westward to Ceylon and Africa, taking root and growing on the coasts on which they drifted.

Mr. Carruthers (Acting Director) for 1902:—"Advice has been given as to the value of *Mimosa pudica,* the sensitive plant, as a nitrogenous manure dug in; the roots of this plant usually contain a high proportion of the nodules caused by bacteria which produce nitrogen, and experiments with this plant are so far most encouraging."

It has been commonly remarked that the use of the coconut palm are as numerous as the days of the year. Food, drink, domestic utensils, materials for building and thatching, wine, sugar and oil, are amongst the many gifts to man of this munificent tree.† Unlike the

* See a very practical paper on "Profitable Coconut Cultivation in Ceylon" by an old planter, page 50, vol. 1886-7, *T. A.* Mr. W. H. Wright at Mirigama has trees coming into bearing at 5 and 6 years and this has also been the case in the Chilaw and Rajakadaluwa districts. See his paper page 22, and another on page 42 of *T. A.* Vol. 1893-4; also others later. For the beginning of cocopalms in Ceylon see pages 337, 352 *T. A.* 1894-5. For taxing palms etc., page 623. 14 acres at Mount Lavinia with 1,151 bearing trees averaged 51½ nuts per tree for ten years—See "Coconut Palm Manual" by J. Ferguson, 3rd Edition (1898 and also much useful information in the "Agricultural Magazine," Colombo. We quote a veteran planter:—

"The method followed by me upon my plantation of 275 acres when planting out the young palms—namely cutting the necessary holes about 3 ft. square and 36 in. deep and burning in them all east-awny wood and all rubbish, and planting the young palms after the ashes thus obtained have been well forked into the soil—is, I observe, being followed by some of the natives with very good results, which they thoroughly appreciate, and I have no doubt that gradually the system will be generally observed."—*Mr W. H. Wright.*

† The following are only a few of the countless uses of this invaluable tree. The *leaves* for roofing, for mats, for baskets torches or chules, fuel, brooms, fodder for cattle, manure. The *stem of the leaf,* for fences, for pingoes (or yokes) for carrying burthens on the shoulders, for fishingrods, and innumerable domestic utensils. The *cabbage* or cluster of unexpanded leaves, for pickles and preserves. The *sap,* for *toddy,* for distilling arrack, and for making vinegar, and sugar. The *unformed nut* for medicine and sweetmeats. The *young nut* and its milk, for drinking, for dessert; the *green husk* for preserves. The *nut,* for eating, for curry, for milk, for cooking. The *oil*

other trade staples of Ceylon, coffee, tea and cinnamon, a very larg proportion of the products of the coconut palm—nuts, oil, arrack leaves for thatch, fences, mats and baskets, timber, &c.—are locally utilized. Arrack in varying quantities (according to the demand in the Madras Presidency) is exported, but the export is not to be compared to the largo local consumption which unfortunately increases with the increasing wealth of the people. The British are blamed for regulating and encouraging the arrack and liquor traffic, but the consumption was considerable before the British appeared in Ceylon. We believe however, that taverns and illicit grogshops are too widely multiplied, and that we should take a leaf out of the Dutch policy in Java, where the consumption of intoxicating liquors among natives is very rigidly restricted. A good many million of coconuts are exported, the trade in this form developing largely of late years, to the Continent of Europe, but the chief trade is in coir fibre from the husk and the expressed oil chiefly used in Europe as a lubricant, specially for soap-making* and dressing clothes, and partially for candle-making and lighting purposes; African palm oil and petroleum being the great rivals. The maximum value of products of the coconut palm exported may be taken at about the following figures:—Oil £500,000; Coir 150,000; Arrack, £2,000; Copra (the dried kernel sent to India for native food and latterly to France to be expressed) £260,000; Nuts, £50,000,000; Poonac, £50,000; Desiccated Coconut £150,000, miscellaneous, products £3,000=say £1,200,000†—while the value of the produce locally consumed must be from 18 to 20 million rupees per annum, and the

for rheumatism, for anointing the hair, for soap, for candles, for light; and the *poonak*, or refuse of the nut after expressing the oil, for cattle and poultry. The *shell of the nut*, for drinking cups, charcoal, tooth-powder, spoons, medicine, hookahs, beads and bottles, and knife-handles. The *coir* or fibre which envelopes the shell within the outer husk, for mattresses, cushions, ropes, cables, cordage, canvass, fishing-nets, fuel, brushes, oakum, and floor mats. The *trunk*, for rafters laths, sailing boats, troughs, furniture, firewood; and when very young, the first shoots, or cabbage, as a vegetable for the table. The entire list, with a Singhalese enthusiast, is an interminable narration of the virtues of his favourite tree.—*Tennent.*

* Soap made at Hultsdorf (and ? other) mills) was exported from Ceylon, 660 cwt. in 1890 worth R24,140; in 1892, the export was only R475 worth; in 1893-4, no exports; while R127 516 worth of soap was imported in 1894. In 1897, exports none; imports 10 670 cwt. R214,644 paying R14,066 of duty In 1902 the imports were 3,909 cwt. of toilet soap valued at R29 620 and 10,817 cwt. of bar soap R122,690.

† The Ceylon Customs give total value—see Trade of Ceylon in Addenda—for 1902 of Coconuts Palm Products at nearly 19 million rupees Of coconut oil we exported as much as 551,000 cwt. in 1892 (the year of greatest export, so far); of Coir about 215,000 cwt. were sent away in 1900, prepared in great part for brush-making—there are 24 coconut fibre factories in the United Kingdom—and a large export trade is springing up in Coconut poonac and copra to the European continent to express oil and for feeding purposes; 40 Coconuts go to a gallon of oil worth R1 to R1½. In Jaffna 1,600 full-grown nuts will give 525 lb. Copra dried=25 gallons oil=2 cwt. fully.

market value of the area covered with coconuts approximates probably to twenty millions sterling.* The extended local use, as well as cultivation, of coconuts is certain to go on with Railway Extension to the North and the development of the coast districts as well as of part of the interior of the island.—Ceylon Coconut Oil in London has varied from average £38 per ton in 1877 to £25 in July 1903; Copra has run up to so high a price as £33-10s per ton, during a great boom in May to June, 1902.

The distribution of the Ceylon coconut products exported may be seen from the following table for the last complete season :—

DISTRIBUTION OF THE EXPORTS OF COCONUT PRODUCTS DURING YEAR 1902.

COUNTRIES.	Coconut Oil.	Copra.	Desiccated Coconut	Poonac.	Coconuts.	Coir.		
	Cwt.	Cwt.	lb.	Cwt.	No.	Rope.	Yarn.	Fibre.
To United Kingdom ..	801647	12908	9378170	21	9316376	...	57508	53488
„ Austria	24774	15364	156300	...	12510	...	195	...
„ Belgium	5853	22944	410730	110621	313620	...	314	22894
„ France	238	110144	38200	...	96020	...	2035	828
„ Germany	18253	172819	2067490	138823	1.69780	...	5556	21150
„ Holland	...	476	328820	...	24415	...	645	2359
„ Italy	1953	...	...	10	11485	...	1077	...
„ Russia	181	33136	...	...	...	...	...	7
„ Spain	...	...	40950	...	...	...	...	...
„ Sweden	1129	...	97130	...	15120	...	..	10
„ Turkey	...	..	...	...	...	..	..	..
„ India	64370	5	1950	...	149500	52	5796	309
„ Australia	9	..	795050	221	1944	20	455	5852
„ America	92026	...	2249143	...	102021	...	3052	6513
„ Africa	218	...	66580	1	1375621	162	25	2551
„ China	84	...	3052	..	...	43	287	...
„ Singapore	1023	..	..	..	..	15354	212	439
„ Mauritius	...	..	..	..	...	...	...	...
„ Malta	..	..	..	...	...	...	...	...
Total Export from 1st January to 31st Dec. 1902	512,498	374,796	16227565	247,697	12583212	15631	77157	11,6,000

Here is an interesting return made up to date of the closing of the old commercial season :—

EXPORTS OF PRODUCE OF THE COCONUT PALM.

TOTAL EXPORTS:	Coconut Oil Cwt.	Copra Cwt.	Coconut Poonac Cwt.	Coconuts No.	Coir, Cwt. Rope.	Yarn.	Fibre.	To at Shipping ton freight appr ximate.	Total approximate value of all.
								Tons.	R.
1st Oct. 1888 to 30 Sept. 1889	327,430	139,871	117,982	4,376,657	9,074	78,702	28,710	60,000	12000000
Do 1887 do 1888	485,758	113,773	114,886	5,411,572	7,913	79,840	22,826	70,000	12500000
Do 1886 do 1887	304,478	108,035	112,180	9,437,818	9,570	69,097	10,546	59,970	11247321
Do 1885 do 1886	231,308	147,894	42,484	a	7,816	74,116	17,419	47,172	9625455
Do 1884 do 1885	471,998	178,361	54,245	..	10,419	84,057	1 ,732	52,533	11376243
Do 1883 do 1884	23,886	177,345	a	...	11,473	85,19	13,672	61,243	14388649
Do 1882 do 1883	306,299	124,827	...	..	11,792	85,896	1 ,00	46,210	10894040
Do 1881 do 1882	183,768	54,004	...	...	7,479	65,885	6,199	28,992	6-93195
Do 1880 do 1881	247,113	43,337	..	..	11,640	43,737	6,117	30,048	7488871
Do 1879 do 1880	316,503	a		..	7,490	56,828	5,862	22,697	8614526
Do 1878 do 1879	211,822	..	...	...	8,201	51,9 5	9,6 6	15,229	6589025
Do 1877 do 1878	112,825	...	...	..	7,410	37,671	5,31	18,176	4844276

a No records previously.

* In taking over land for public purposes each bearing coconut palm is valued at R10, and in Native Gardens, there are 80 to 100 trees at least per acre—let us say £50 an acre, and without counting young or old palms that would give us for 500,000 acres, a total value of £25,000,000 !

We supplement this with the export for the past ten calendar years according to the Chamber of Commerce return :—

Total Exports from 1st January to 31st December.

	Coco-nut Oil cwt.	Copra. cwt.	Desicca-ted Coconut. lb.	Coconut Poonac. cwt.	Coconuts.	Coir, Cwt.		
						Rope.	Yarn.	Fibre.
1902 ...	512498	374796	16227565	247697	12588212	15631	77157	116000
1901 ...	453531	439865	14055493	204356	14850781	13030	75788	122826
1900 ...	443959	362467	13604913	185992	14995909	12572	87415	115090
1899 ..	400979	325401	13571084	174786	11723392	12090	75525	91588
1898 ...	435933	306277	13040534	216620	12027714	12333	75819	95779
1897 ...	409600	106601	12054452	192,479	13610508	11732	91460	74470
1896 ..	343797	50049	10603598	138358	13858881	10343	68326	56516
1895 ...	394140	30765	8551073	174175	10800712	12082	90112	77226
1894 ...	487571	30612	5722202	165156	8292699	14116	91746	67738
1893 ...	389712	44923	6414908	188588	11079028	7819	84831	56404

A great enemy in Ceylon to trees between their 5th and 10th years is the large Kuruminiya beetle. Caterpillar blight is also not unknown in Ceylon in isolated patches. For a couple years, fear was excited in the Western Province about a supposed coconut leaf disease, but Dr. Trimen has dispelled the idea of a fungus or other serious attack—see the remarks in his Administration Report for 1889. See also Reports by Mr. Drieberg of the Agricultural School in *Tropical Agriculturist* of 1889-90. Since then, nothing has been heard of any disease, and in his Report for 1900, Mr. Willis says of Coconuts :—

"The industry seems in a prosperous condition, and the trees are on the whole remarkably free from any serious disease, considering how long they have been cultivated in the Island." The appointment of a Coconut Palm Inspector in the Straits, is an example that should be followed in Ceylon, giving him power to prevent overcrowding of plants as well as neglect of beetles, &c.

The coconut palm was long supposed to be a native of South America, and to have been introduced thence to the Eastern Hemisphere : but De Candolle in his "Origin of Cultivated Plants" concludes its original home was rather in the Eastern Archipelago between the Andamans (which now yield 15 millions nuts a year) and New Guinea. It is found nearly everywhere within the tropics, and to the palmivorous inhabitants of many countries it is almost their sole dependence for food.* Bennett speaks of five varieties, in Ceylon and says the coconut nowhere else acquires the height it does in this Island. A tropical native with twelve coconut trees and two jak trees in his garden is said to be independent.† Although strictly a

* A case is reported in 1883 from the South Pacific of a shipwrecked crew on an island there, living for months on nothing but coconuts (fish very occasionally) and flourishing and gaining weight.

† Tennent notices a case in Ceylon where a claim in court was for the 2-52 pa of ten coconut trees.

tropical plant and flourishing best in maritime belts, yet the coconut grows up to 26½° N. Lat., as far as Lucknow in India, and as we have said up in the interior hill-country of Ceylon for 100 miles from the sea at an elevation of 2,000 feet (or up 3,500 feet though not bearing), also in the lowcountry of the North-Central Province quite in the interior. In the Madras Presidency along the Malabar and Coromandel coasts there are perhaps, 250,000 acres planted with the coconut palm, which is also abundant in the Maldives and Laccadives. The native state of Travancore alone exports copra, coconut-oil, coir and coconuts to a considerable amount, perhaps 5 lakhs of rupees yearly. India exports from 1¼ to 2 millions gallons of coconut-oil annually, but also imports over a million; exports 40,000 to 60,000 cwt, of coir yarn, besides 400,000 cwt. manufactured and 40,000 cwt. coir rope; and copra up to 90,000 cwt. For India altogether we should be safe in giving 350,000 acres under cultivation; but India imports over 10,000 cwt. copra and over 18 million coconuts. In the Straits Colonies, (Singapore exports 120,000 tons copra), Penang more especially, it flourishes, and in Java and Sumatra as well as throughout the Eastern Archipelago, the Philippines (exports 35,000 tons copra, 500 tons coconut oil and 8 million nuts in 1899) and New Guinea. The cultivation of coconuts and other palms is receiving attention in French Cochin China, about 60,000 acres having been reported as planted with immense room for extension; also in Siam and in New Guinea. In Zanzibar (£90,000 of copra exported in 1893) and along the African coast, specially in the German, British and Portuguese settlements the coco-palm is freely planted, with large exports of copra, oil and nuts. A native chief has some on a lakeside beyond Nyassaland. The coconut plantations in Demerara have been fearfully devastated by the attack of a small beetle (*Passalus tridens*); in Jamaica there is trouble with a scale insect in very dry weather.

In Jamaica (also Bahamas) coconut cultivation is being much encouraged, about 14,000 acres being planted, export 10 millions of nuts; also in Trinidad, where 5,000 acres are planted, 8 millions nuts exported and 2 oilmills at work. Dr. D. Morris is of opinion that there is great scope for profitable coconut cultivation round the coast of the West Indian Islands, a convenient market being found in the United States. He counts on £10 per acre covering all outlay at 60 trees to an acre, till trees are in bearing. Mexico exports £250,000 of coconut oil; Venezuela has numerous coconut groves. as also South and Central America. There are coconut groves 300 miles long on

the coast of Brazil, whence a good many millions of coconuts are sent annually to the United States. The cultivation is also being extended in Northern Australia with success. In the Pacific Isles, New Caledonia, Fiji (20,000 acres and 100,000 cwt. copra exported, &c.) the palm is very abundant.

APPROXIMATE ESTIMATE OF AREA CULTIVATED WITH THE COCONUT PALM.

Ceylon	Acres 650,000
British India and Dependencies ...	390,000
Central America	250,000
Eastern Archipelago, Philippines, N. Guinea & Straits Colonies	350,000
Java and Sumatra*	250,0 0
Mauritius, M'gascar, Zanzibar, Seychelles, Réunion, & A'can Cst	110,000
Pacific Islands, including Fiji, New Caledonia, &c. ..	260,000
Siam and Cochin-China	100,000
South America	500,000
West Indies	110,000
Total...	2,970,000

with perhaps perhaps 210,000,000 trees bearing fully 6,400,000,000 nuts every year, the larger proportion of which are consumed for food purposes where produced. Coconut-oil for lighting purposes used to be very generally consumed in India and the Eastern Archipelago and also throughout the Pacific, but it has been almost entirely superseded by the mineral kerosine oil, which is being imported in increasing quantities every year from America and Russia† and is cheap and good. In European countries although large quantities (for soap-making, &c.) are still sent there from Ceylon, India, the Straits, Sydney, and the Pacific, yet the African palm oil has competed with it in the market.‡ The African oil palm has been planted in Ceylon and grows well in Lower Haputale and Kelani Valley.

Coir is exported chiefly from Ceylon, Madras and the Straits; coconuts from South America, the West Indies, as well as the East. The export trade of India in all products of the coconut palm is equal to an annual value of £400,000, but she imports £150,000 worth of nuts and copra; of Ceylon rising above the million sterling (with large home consumption both in Ceylon and in India); of the Eastern Archipelago, Java, and Saigon, £200,000; of the Pacific Isles and Australasia, £150,000; of Central and South America, 300,000; of the West Indies, £100,000; and £100,000 for the rest of the world's trade in coconut produce. Fiji's export of copra rose from 2,397 to

* Java exports in some years, 500,000 cwt. copra.

† Now being found in Burma.

‡ The West African oil palm has of late years supplied most of the oil imported into Britain, the quantity having risen from 300,000 to 1,000,000 cwt. per annum in thirty years, while a good deal is also sent the United States and Marseilles direct. Castor (200,000 cwt.), Olive and Seed Oil are also available.

5,000 tons between 1875 and 1885, but has since fallen off. 40,000 tons copra a year pass through Singapore.

An important industry in preparing Desiccated Coconut for confectionery has sprung up in Colombo, at Veyangoda, Negombo, Madampe, Kurunegala and other points in Ceylon under European, and later, under native auspices, and in 1902, the export of the product equalled 16,227,565 lb. (requiring nearly 50,000,000 nuts) valued at 20 cents a lb. locally or a total in Customs accounts of R2,870,000 (£190,000).—973 cwt. "Coconut shells" were exported to India in 1902, valued at R32,623.

For full practical and general information see the compilation "All About the Coconut Palm" published at the *Ceylon Observer* office, new edition 4th and enlarged edition in the press (1903).—see an interesting official report on Ceylon Oils exhibited at the Colind Exhibition, in Supplement (page *f*) to *T. A.* vol. 1886-7. On manuring Palms, see *T. A.* Vol. 1898-9, page 797.

COCONUT CULTIVATION.

(From the *Ceylon Summary of Useful Information and Plantation Gazetteer*, for 1859.)

COMPILED BY THE LATE A. M. FERGUSON, C.M.G.

Jaffna, as the scene of the most extensive experiments in coconut culture by Europeans, first claims our attention. Sir Henry Ward, in a Minute descriptive of one of his tours in 1857, thus noticed the Jaffna coconut estates, their condition and prospects:—The coconut estates of the Northern Province are confined to the Patchelopalli district, which extends from Kodigama to Pass Beshuter. The principal estates lie between the 17th and 28th milestones, right and left, on the road to Jaffna. There are only two estates —that of Mr. Dunlop, and a new clearing belonging to Messrs. Wilson and Ritchie,—beyond the 28th mile: but the whole of the estates depend upon the main line of road for their supplies, and the conveyance of their produce to the Port of shipment, which is either Point Pedro or Jaffna. It is, therefore, of the greatest importance to them, that this road should be completed, and it was under the belief that it would be so,—though I am not aware of the existence of any positive engagement to that effect,—that, as I have already stated, 10,000 acres of Crown land were bought.

and £200,000 expended in bringing it to its present high state of cultivation.

"Having inspected, personally, six of the principal estates, and other gentlemen of my party having visited several of the remainder, I am enabled to state that they are all in a most satisfactory condition,—well fenced, well cultivated,—and rapidly approaching the period when a very large amount of copperah, or oil (should steam machinery be established at a convenient point), may be prepared for exportation."

To a correspondent who was at an early period connected with the enterprise we owe the following interesting notice:—

"Europeans first turned attention to coconut planting in the Northern Province of the island so far back as 1842, during which and following years small portions of the two oldest estates were planted, and clearings rapidly increased up to 1849 and '52—but of late years the cultivation has not been extended to an equal extent, the result not being so satisfactory as was first anticipated, and the chance of any remunerative return being more remote than was first estimated.

"The expense attending the upkeep of the properties has necessarily been curtailed as much as possible, and probably in some instances to the detriment of the trees, for there is little doubt of ploughing and manuring being highly efficacious to their productiveness.

"The coconut tree is said to bear well from the 9th or 10th year of planting, but experience does not justify this assertiont in the Northern Province, for we have no export of oil from tha, quarter as yet of either plantation or native produce, though several hundred acres are from 10 to 15 years old.

"The collection of nuts is, however, generally on the increase on the oldest estates—these are converted into copperah which is sent to Colombo, and also Coastwise, where it sells for a high figure, being generally of a fine pure quality.

"The nature of the soil is light and sandy, in which the coconut undoubtedly thrives best, when carefully cultured and plentifully watered in its tender age; but the planters' great enemy is the Cooroomenia or coconut beetle, which is found to be most destructive to the trees between the 5th and 10th years, when they expand and first blossom. Trees so attacked seldom

recover and are immediately replaced with young plants, which cause a heavy item in the upkeep of the properities. The country is generally very level, and the best lands are those where surface water is procurable at a depth of 6 to 9 cubits in a light soil, a stiff clayey sub-stratum being very objectionable.

"The climate may be considered a dry one, there being little rain except during the months of October, November and December, and again at the change of the monsoon in April and May.

"The Northern Province is famous for its good roads, and the planters have the advantage of the main trunk line passing through the district of Patchelappalle in which the estates are chiefly situated. The labour employed is entirely local, and can be obtained at cheaper rates than in any other part of Ceylon."

A second gentleman, to whom we are indebted for the list of estates, accompanied it with the following remarks:—

"Coconut estates have been planted since 1841 (I think) and now cover about 9,000 acres, cultivation still being extended. For some 4 or 5 years proprietors were so discouraged at the non-receipt of anticipated profits that they reduced the expenditure on the estates to a minimum. Since a more liberal expenditure has admitted of higher cultivation, there has been a vast improvement—during the last two years this has been very marked. All the estates have more or less young cultivation, so that it is not easy to strike an average of the bearing of the trees; again, some estates or parts of estates are planted at 20 feet apart giving 108 trees to an acre; some at 30 feet giving only 48 trees to an acre—others at intermediate distances—so that it is not easy to give the number of trees. Statistics go far to prove that the annual increase of nuts throughout the district is from 50 to 78 per cent, an increase very unequally divided between the estates according to age and cultivation. This year's crop will be between 3 and 4 million nuts.* There are a few estates which have never been cleared and 4 or 5 blocks—about 1,000 acres surveyed but unpurchased—not much other Government land available for coconuts. I cannot estimate the quantity of coconut land held by Natives, but there must be two

* In a subsequent communication the writer says:—"I begin to think that trees planted at 30 feet apart will yield more nuts per acre than the others. Time is required to decide the question." He then refers to a beautiful estate planted 20 feet apart where the trees do not bear anything like what their appearance would indicate. On a part of the estate indigo was planted, but this was only for a year; still it may be the cause of the deficiency of nuts.

or three times as much as the extent held by Europeans, and their cultivation is increasing rapidly. The produce is principally sold as copperah, which is shipped in large quantities to Colombo and different parts of the Coast, being of such fine quality as to command a high price. At Calcutta it would doubtless compete successfully with that shipped from Quilon and Aleppee. Coir is only manufactured at Jaffna for the market, excepting at an establishment at Chavakachcheri. This arises from want of facilities for preparing the husk when there is a command of labour. The coir manufactured at Jaffna (entirely by natives) can be purchased at ½*d.* per lb., and is good in quality and procurable in tolerably large quantity. You know the climate of Jaffna, so I need not say that our chief want is rain, as we have little except in November and December. This, however, secures us very fine copperah. About 1,200 estate nuts and 1,400 village nuts give a candy of copperah 560 lb. Another great want of the Planters is mills for the manufacture of oil. Why should not we get as high a price for our copperah as is given in Colombo, when oil manufactured on the spot might be shipped direct to England? Beetles are not nearly so destructive as they used to be."

Taking the Eastern Province next in order to the Northern, we come to Batticaloa, where coconut planting by Europeans was commenced much about the same time as in Jaffna. The climate is moister than that of Jaffna, and so far more favourable. Cotton cultivation was tried by the European planters at Batticaloa, but we believe, with no more success than attended similar efforts at Jaffna. We are indebted to a resident planter for our list. Sir Henry Ward, in the account of his tour in 1857, thus notices the coconut cultivation of Batticaloa:—

"Between Karankotativu and Naypatemone—the southern extremity of the Batticaloa lake—we passed through the coconut estates under charge of Mr. O'Grady. Farther north, between Ondatchy Madam and Karan Colom, are those of Mr. Carey; and the estates of Mr. Munro and Colonel Spencer, under the charge of Mr. Robertson, lie 20 miles more to the North again, between Eraur and Ballechena.

"Mr. Gordon Cumming's estates are near Karan Colom. We saw, therefore, a fair proportion of the 4,000 acres said to be planted with coconuts in the Batticaloa districts. Generally speaking, I do not think them equal to the Jaffna plantations, or comparable to those

about Natande and Madampe, in the North-West Province. But none of the estates are yet in full bearing, having only been planted between 7 and 9 years. About 70,000 nuts, which are brought by the Moormen, at from £3 to £4 per 1000, was the last year's crop at Karativu; but this may be expected to increase annually as the trees gain in age and strength.

"Mr. Carey's estates are models of neatness. The nursery for the young plants is like a garden. The clearing and planting cost £5 an acre, which may eventually be reduced to £4. This includes the wells to be sunk, which are numerous, as the young plants require watering every day for the first year. The water is found at from 5 to 8 feet. The system pursued by the gentlemen named appears to vary little. They all manure highly. None have tried salt, and do not attach much importance to it as a manure. But this may, perhaps, be owing to the fact, that the soil itself is strongly impregnated with saline particles, especially that which is dug in the marshes near the estates, and spread over the roots o the trees."

It is curious that the planters of Batticaloa attach so little importance to salt as a manure, for Dr. Gardner stated that in Brazil as much as a bushel a tree was applied when salt was at 2s. per lb. No doubt His Excellency has adduced the true reason why the application of salt is not required at Batticaloa.

We believe the Governor's estimate of 4,000 acres in cultivation is rather above the mark. A planter connected with the district tells us that about 3,000 is nearer the figure.

There is one estate at Trincomalee, Ootoo Oday, the property of Mr. J. Wright. It is situated in one of the deltas formed by the Mahavillaganga where it enters the sea in Tamblegam Bay, and promises well."

[There has been a great extension of coconut planting in the Batticaloa District since this was published.—*Compiler.*]

CENTRAL PROVINCE.

In the Central Province plots of coconut trees are few and far between, and so much prized that some which required to be cut down in the formation of the telegraph line, near Kandy, were valued at £5 each. At Badulla there is a good coconut garden flourishing at an altitude of 2,000 feet; but generally the coconut

does not thrive well beyond the influence of the sea breeze. There is a pretty legend of a Rajah of the Inland regions of Ceylon being afflicted with leprosy, of which he was told in a dream he would be cured by resorting to the sea shore and drinking the juice of the nuts of a strange tree he would find there growing. The Rajah resorted to the sea shore and found all as he was led to expect; the trees were there, but no inhabitants. The latter incident, unfortunately, violates all principles of even legendary probability. Coconuts have doubtless floated to the Asiatic Islands on the sea, but a country is not usually peopled from its centre outwards. In our notices of the coffee districts we have mentioned the attempt made at sugar cultivation in the Vale of Dumbara, and the more successful one at Peradeniya, where a sugar estate is still kept up. Cotton was, we believe, tried by a Mr. Pooley and others in the neighbourhood of Matale, where the soil and climate are favourable. But until our population increases and labour is cheapened, or until the Manchester men give a higher price for cotton, we fear this cultivation will not succeed in Ceylon.

WESTERN AND NORTH-WESTERN PROVINCES.

A correspondent who has had large experience in the cultivation of coconuts in the Western and North-Western Provinces, writes as follows:—

"There is great anxiety manifested by the natives to cultivate coconut trees, and large purchases of land have lately been made for that purpose and estates also opened.

"As to climate and soil for the purposes of this cultivation, I am of opinion, that the face of the country from Dandugama to Madampe, is one of the best districts of the Island. The soil may be divided into three descriptions, and which are to be treated separately as follows:—

"1st.—White sandy oil, porous, light and poor in the extreme, and in which coconuts thrive badly and take a long time to come into bearing. To plant this soil contractors will jump at the offer, as the jungle is mostly very light and the operations of cutting, burning and rooting inexpensive; the Natives themselves won't plant much of this description of soil for their own use. There is another description of this soil, a shade more mouldly and better adapted to this cultivation.

"2nd.—Dark loamy soil, which suits coconut trees very well, and in which by observing first principles in choosing nuts for plants

* By "first principles" we believe our correspondent means, choice of good, healthy, *fully-ripened* nuts.

the trees could be brought into bearing five years and be worth from £10 to £12 per acre annually at present rates of copperah, viz., £3 7s. 6d. per candy first quality.

"3rd.—There is also in this fine district a reddish loamy soil which is most excellent for coconut cultivation, which is about £2 per acre annually more valuable than the soil I have just been describing.

"The cost of clearing depends on the density of the jungle or forest, and may be calculated per acre at £2 or £3 to £4 10s., I mean for cutting, burning and rooting, for to cut down, burn and plant, without rooting, is one of the greatest mistakes ever a proprietor made. The rotten stumps become infested with beetles, which ultimately devour a large proportion of trees, and the young jungle, constantly growing up, becomes infested with wild pigs which feast on young trees in al directions, so that a proprietor loses fearfully in the long run by adopting native or cheap principle. I would not tolerate a man on a property who allowed a single jungle root to remain in the ground, so as to be reproduced. The native profit largely when they plant coconut trees by contract, as they invariably sow their own seeds which deteriorate the soil, for the cutting and burning of which the proprietor pays dearly. They reap a speedy and heavy profit, whilst the proprietor is injured in proportion.

"After planting, cultivation may be carried on at from 7*s.* 6*d.* to 10s per acre annually by means of ploughing—I mean including all expenses, comprising—superintendent, watchers, bullock watchers, kanganies, coolies, beetlemen, &c. Young trees must be watered in dry weather at least twice a week; they must be cleaned about, and kept free from weeds and creepers, at least four times a year—I mean the surface close to the trees where the plough can't reach.

"Now for yield of coconut trees after coming into bearing: 5 years to 8 perhaps as stated, but this depends altogether on climate, soil and the selection of a particular species of nuts for plants, and which species the rain or damp weather cannot injure. It has a tough kernel, and this leads me to state that oil expressed from this species might be as firm as tallow in the home market. With fair average soil, good climate and even cultivation, as I said before the average yield ought to be about 50 nuts annually per tree, and by the introduction of the cheapest and best mode of manuring in this country, the average yield ought to be about 80 nuts per tree annually, and which nuts are from 12*s.* to 15*s.* per 1,000 in

weight more valuable than the general run of the country. I give general results—as about houses, where ashes, &c., are about the trees, you could no doubt get nuts quite as large as any I could cultivate, but for an average general result like that above they can't be found.

"It is said that coconut trees are in full bearing at from 20 to 30 years, and that their entire duration is about 100 years —some natives say 150—but of course this information is all hearsay and I cannot myself give reliable information.

"The proportion of trees destroyed by beetle is very small if the preceding precautions are observed, and the hands, say one cooly to 100 acres, are instructed and provided with proper tools for catching them when they imbed themselves in the young trees.

"Coconuts, as food, are in general use amongst the Sinhalese —a small complement of the kernel grated on the curry plate is considered a very nice relish and very wholesome.

"Labour I find to be plentiful at all seasons: on the principle, the self-evident one, of good treatment, and regular payments—I never yet advanced 10*s.* for labourers—my coolies always fill up their places before going to their country if I am much pressed for labour.

"The means of communication are on the whole very good throughout the district—fair average roads and the canal open with some annual drawbacks.

"P. S.—I ought to state that an estate in this district, 800 acres with about ¼ of the trees in full bearing, gives now in the year about 600,000 nuts worth, at present copperah rates, about £3 3*s.* per 1,000. Hurrah!!"

The estate alluded to is, we believe, that of Horekelle, once the property of Mr. David Wilson, but latterly of the Horekelle Company, Limited. From first to last it has been highly cultivated and manured, and was at one time, we suppose, the finest coconut property in Ceylon.

[Immense extensions of coconut planting in the Western and North-Western as well as Southern Provinces have taken place since this was written.—*Compiler.*]

VARIETIES OF THE COCONUT IN CEYLON.

Moon, in his *Catalogue* (1824), enumerates the following varieties :—

Native Names.	*Translation.*	*English Names.*	*Scientific Names.*
Pol.	Coconut.	Coconut.	Cocos nucifera.
(1) Giu	Fire	—	—
(2) Gundira	Maldive	—	—
(3) Tæmbili	Copper-coloured	King	—
(*a*) Ratu	Red	—	—
(*b*) Kiri	Milky	—	—
(*c*) Gon	Bullock	—	—
(*d*) Ran	Golden	—	—
(4) Nawasi	Sweet or edible-husked		—
(*a*) Nil	Green	—	—
(*b*) Ratu	Red	—	—
(5) Pæni	Sweet	—	—
(6) Bim	Ground	—	*Trichopus Zeylanicus*, Gært.
(*a*) Bu	Downy	—	—
(*b*) Maha	Great	—	—
(7) Ratu	Red	—	—
(8) Waga	—	—	*Carculigo recurvata*, Rox.

127. Cocos, *Linn. Gen, n.* 1223.—Flores in eodem spadice interfoliaceo simpliciter, ramoso monoici, bracteati, m. in parte superiore ramorum numerosi solitarivel 2-ni, conferti vel sparsi: f, in parte inferiore sparsi, sessiles vel pedunculati, solitarii vel flore masculo utrinque stipati. Fl. male asymmetrici. Sepala parva, triangularia vel lanceolata, acuta, erecta, valvata. Petala oblique oblonga, acuta-erecta vel patula, valvata. Stamina 6, inclusa, filamentis subulatis ; antheræ lineares, acutæ vel obtusæ, basi 2-fida affixæ, erectæ. Ovarii rudimentum minutum vel 0-Fl. f. masculis sæpissime multo majores, ovoidei, perianthio post anthesin aucto. Sepela ovata vel ovato-lanceolata, crasse coriacea, erecta, imbricata. Petala sepalis inclusa, coriacea, basi dilatata, convolutivo-imbricata, apicibus brevibus vel elongatis acutis conniventi-valvatis. Discus annularis vel obscurus. Ovarium ovoideum vel depresso-globosum, 3-loculare, loculis 2 sæpius effœtis, in stylum brevem attenuatum, stigmatibus subulatis erectis demum recurvis ; ovula subbasilaria, adscendentia. Fructus ovoideus vel ellipsoideus, terus vel obtuse 3-gonus, vertice rostrato rotundato

vel intrinso, 1-spermas. stylo terminali, pericarpio crasso fibroso, endocarpio osseo extus fibroso basin versus 3-poroso. Semen loculo conforme, testa fusca raphea ramil reticulata, albumine æquabili cavo vel solido radiatim fibroso; embryo poro uni oppositus.—Palmæ humiles vel elatæ, inermes, caudice gracili vel robusto annulato sæpe basibus foliorum tecto. Folia terminalia, pinnatisecta, segmentis ensiformibus vel lanceolatis æquidistantibus vel aggregatis 1-plurinerviis apice integris vel uno latere dentatis vel plus minus profunde laciniatis, marginibus lævibus basi recurvis rhachi subtrigona superne acuta, dorso convexa, petiolo antice concavo marginibus lævibus vel spinosis, vagina brevi aperta fibrosa. Spadices erecti, demum cernui, ramis erectis vel cernuis: apatha inferior brevior apice fissa, superior fusiformis vel clavata, lignosa, dorso sulcata: bracteæ variæ. Flores albi vel flavidi. Fructus magnus vel mediocris.

Species enumeratæ ad 30, Americæ tropicæ et subtropicæ australis incolæ, una in tropicis amphigæa. *Mart. Hist. Nat. Palm* ii. 113 (*excl. sp.*), *t.* 62. 64, 75, 78, *ad* 82, 84 *fig. dext and* 86, 87, *f.* 1, 88, *f.* 3, *ad* 7; iii. 289, 323; *palm. Orbign.* 92 (*excl. sp.* 4), *t.* 1, *f.* 1, 2, 3, *f.* 2, 9. *f.* 2, 30 B. C. *Kunth, Enum. Pl.* iii. 281. *Lam. Illustr. t.* 894. *Gaertn, Fruct. t.* 4, 5. *Spach, Suites Buff. t.* 100. *Drude in Mart. Fl. Bras.* iii. ii, 398, *t.* 87 *ad* 97. *Barb. Rodrig. Enum. Palm. Nov.* 83. *App. Protest.* 43. *Roxb. Cor. Pl.* i, *t.* 73. *Griff, Palm. Brit. Ind. t.* 241. *Wallace, Palm Amaz.* 124, *t.* 48. *Trail in Trim. Journ, Bot.* 1877, 79. *Drude in Griseb Symb. Fl. Argent.* 283. *Spruce in Journ. Linn. Soc.* xi, 161, *Hook. Kew Journ.* ii. t. 1, 2. *Trim Journ. Bot.* 1879. *t.* 202.

THE CULTIVATION OF THE COCONUT PALM ("COCOS NUCIFERA") IN CEYLON.

(By a practical Coconut Planter.)

INTRODUCTION.

We do not find in the coconut tree, as it appears in Ceylon, the characteristics of an indigenous plant; we do not find it growing to maturity, and producing its seeds in the midst of other natural growth; but wherever nature resumes her sway, and maintains it, for a few years, on land in which this palm grows, we see it pine, cease to bear fruit, and ultimately die off: the neighbourhood and agency of man seem necessary not only to its propagation and well-being, but to its existence. It is only found as a cultivated plant;

starved and neglected indeed it may be, but never totally abandoned to nature, for a long period of years.

Though we may not grant it a place with indigenous plants we must admit that it has from a very remote antiquity ministered to the comfort of the inhabitants of the South and South-West coasts of Ceylon. It enters into every part of the daily life of the Sinhalese as food, drink, light, fuel, household utensils, and building materials; and since it has become an article of foreign commerce, it is the chief source of Sinhalese wealth and an important field of Sinhalese industry.

PRODUCTS OF THE COCONUT PALM.

Oil holds the first place in the exported products of the coconut palm: the progress of the trade has been, from 377,000 gallons, average annual export in the five years ending in 1851, valued at R290,000, to 5,297,565 gallons, the average of five years ending in 1893, and valued at R5,539,364. For fifteen years previous to 1851 the export of this article had been stationary, or rather declining. The cause of the rapid increase in the last forty years was the planting of extensive fields, by European colonists, which have been gradually increasing their yield.

The product of the coconut-palm second in importance to oil as an article of commerce is coir—the fibre of the husk. Not one-thousandth part of the husk produced in the island is manufactured. In five years ending 1851 the average export was 30,508 cwt., valued at R143,660; in 1893 the average of five years was 145,242 cwt., valued at R1,001,984; thus in forty-three years, while the export has increased over 450 per cent., the local value has increased from R4½ to R7 per cwt. In 1896, the export was 161,761 cwt., valued at R1,106,388. Machines driven by steam-power have been constructed for cleaning the fibre, but the great bulk of the coir exported is still prepared in the old way. The husks are thrown into a pool of brackish water, and left to ferment, after which they are dried, and the fibre beaten free by women and children. The wages to be made by this labour are very scanty; yet it is a domestic occupation that slightly mends the means of thousands of poor families.

Coconuts, copperah and arrack are not exported in large quantities, or to any certain market, as is the case with poonac. Copperah is the dried kernel from which the oil is extracted; poonac, the oil-cake that remains after the oil is pressed out. Toddy, from which arrack is distilled, is obtained by cutting off the ends of the

flower spikes about the time that they burst the sheath. The branchlets are tied tightly in one bundle, the end of the bundle is cut off, an earthen pot is attached to receive the flowing juice, and when the pot is removed with its contents a piece more is cut off the spike, to remove the ends of the sap vessels dried up and contracted by exposure. The sap thus collected is distilled into the spirit called arrack, which, though not an important article of foreign export, affords, through the excise levied on it, a very important branch of the Colonial revenue, the receipts in 1873 being over £180,000.

CULTIVATION.

CLIMATE AND SOIL.—The lowest average temperature that the coconut will thrive in is 80 degrees Fahrenheit. In that temperature, less annual rainfall than 70 inches injuriously affects its crops. The most productive soil is the alluvial flats by the banks of large streams that are not too frequently or for long periods flooded. The second best soil is the deep brown gravelly loam, that is not prevalent in Ceylon, but is frequently met with both in low and mountain country: for instance, there are few better soils in the island than the vale of Matale offers for the plant, and as the other conditions of prosperous cultivation are found here, perhaps our great-grandsons may overlook from the Balakaduwa Pass a coconut field, extending beyond the most distant spurs of Ambokka. The third quality of soil for coconuts, and the first in its capacity to respond to high cultivation, is a deep loamy sand. In alluvial land, the efforts of the cultivator must be confined to keeping down the indigenous growth; on the rich brown loam, operations must, for a long series of years, be the same in principle, only less in degree. It often happens in Ceylon that land of third-class natural fertility is most profitable to the cultivator: this indeed should not happen under a good system, but good systems are of slow growth, and have hardly yet reached the practice of the most enlightened of Ceylon coconut planters. Coconut cannot be planted profitably on a surface steeper than one in fifteen: cabook hills are especially to be avoided, where they have a greater inclination; clay and peat, inert, loamy and heavy retentive soils of all kinds are to be avoided.

PLANTING.—Almost all the old native gardens have been planted higgledy-piggledy, often 200 trees to the acre, beside jak, mango, kaju, and other trees. Your genuine native firmly holds the faith of the more trees the more fruit, and will rather discredit his

senses than admit that system handed down from his remote ancestors can possibly be wrong. This system would soon work itself out, but for the fact, that the whole rural population dwell under the shade of the coconut groves, and wherever man and his attendant domestic animals reside there is a constant process of natural manuring in progress. It is now some twenty-six or twenty-seven years* since Europeans began to plant coconuts on a large scale in Ceylon. The favourite localities were then Jaffna and Batticaloa, but many detached properties were planted throughout the Southern and Western Provinces. The habits and wants of the plant were so little understood in those early days of planting, that very many mistakes were made. In a great majority of cases the land selected was naturally barren; the climate of the Northern and Eastern Provinces turned out to be too dry; the estimated cost of bringing the fields into bearing had to be trebled; the period estimated between planting and bearing was doubled, and the crops seldom reached one-half of the original estimates. In consequence of all this, coconut planting has been a comparative failure; and even the most valuable estates yield a very low percentage on the capital invested. Things would have been very much worse but for a circumstance never calculated on in the original estimates that is, the value of the produce has nearly doubled since the estates were planted. From 1848 to 1858, coconut planting was almost entirely suspended throughout the island, but in or about the latter year several circumstances combined to give it a fresh impulse. Government took measures to put into the market large tracts of land, in lots suitable to all purchasers, from 20s. to £1,000; the value of coconut oil had continued to rise gradually, for a series of years; the general prosperity of the colony had enabled vast numbers of natives of all ranks and professions to save more or less money, and true to the native habit of mind, they could not think it perfectly safe, till invested in immoveable property. The coconuts planted between 1840 and 1850 were chiefly by Europeans; those planted within the past fifteen years* are almost entirely by natives. The movement has been general throughout the Western Province, and the extent planted is immense. Taking the country alone between Katukenda and Giriulla, a distance of ten miles: in 1860 it was an almost uninterrupted forest for the whole ten miles: there are now 10,000 acres planted with coconuts, and in the three miles between Katukenda

* Written in 1873.

and Dalpatgedera alone there is a single field containing nearly 5,000 acres, more than four-fifths of which have been planted within eight years. In this district there is now, under one view, the largest systematically planted field of coconuts in the island, and the general soil of the whole valley is of a superior quality and may be expected to be very productive; yet it is only a mere fraction of the aggregate extent planted in the past ten years. In view of the vast increase that must take place in the supply of this staple within the next fifteen years, it is a serious question, whether the market will expand to absorb it all. It is true that the price has risen 25 per cent in the face of a supply nearly quadrupled, in the last fifteen years, but with the prospect of the supply being again quadrupled in the next fifteen, and of the increasing receipts in Europe of West African palm oil and of petroleum oil, producers will not act unwisely in habituating their minds to the contemplation of a considerable decline in prices.* This is, however, a mere speculation, and we have no right to look with gloomy forebodings into the future, if we do our best in the present.

SEED-NUTS.—The kind of soil suitable for coconut cultivation has been already indicated: the next step is the selection of seed nuts. These should be the produce of healthy, heavily-bearing trees; ripe, but not dry; of a bright green colour; of an oval shape, with a thin husk, and the three longitudinal ridges on the husk not prominent.

NURSERY.—The land selected for nursery ground should be light and free, prepared by trenching eighteen inches deep formed into three feet beds, with two feet intervals; the earth should be removed to the depth of six inches, and piled in the intervals; pack the nuts close together in the beds, with the stalk ends up; return as much of the earth as will fill up all the open spaces between the nuts, leaving only the crown above the surface; settle the beds with a good jar of water, and then cover with three or four inches of cinnamon scrapings, or, if that is not to be come at, lay six inches of straw or grass over the beds. Water from time to time, if the weather is dry, and the plants will be ready for removal in from five to six months. All plants that have been tardy in springing, and all that have not a healthy,

* Written in 1873.

vigorous appearance, should be rejected, as the first condition of an equal and healthy field is quick-growing seedlings.

TRANSPLANTING.—The common practice is to transplant the seedlings from the nursery to the field direct: but a plan suggested by an experienced Jaffna planter, some years ago, is worthy the careful study of every one proposing to create a coconut field. This plan was to select pieces of good land convenient to water and to plant the seedlings at five feet apart: to concentrate high cultivation on those spots, till the plants became strong and vigorous while the land they were finally to occupy remained untouched It was then proposed to clear the land, and transplant the trees to their final destination. The advantages of this plan are: that one man's labour will do more to advance the growth of the trees than could be done by that of twenty-five men in the wider space; that the larger surface is preserved for two or three years from the soddening influence of sun and rain on unshaded land; and that the plant can thus avail itself of the virgin strength of the soil, when it is much better fitted to avail itself of it, than in its infant state. The only disadvantages are, that the removal to a new locality of a plant of three years old is more costly than one of six months; but much more than this is gained by the quicker growth and the smaller cost of cultivation; and that transplanting always check, the growth of a plant, and the older it may be the danger is the greater. This is true of most plants; perhaps of all. But the coconut is less thrown back by transplanting at *any age* than almost any other plant, and three months under the most unfavourable circumstances is the utmost suspension of growth; trees of twenty years' standing have been transplanted that did not lose one leaf the sooner for the operation.

FELLING.—If the land to be planted is old forest, it should be felled about a month before the usual time that the first rains of the season fall. In from fifteen to twenty-five days after felling, fire should be set to the fallen timber, and this should in no case be deferred till the leaves have fallen, or till the undergrowth has made any progress. A good running fire is the means of saving much labour, not only immediately, but during subsequent years. On chena land the operations are the same, but as the timber is lighter the leaves fall sooner, and the undergrowth appears earlier; the fire should therefore be run in ten or twelve days after the felling. In old heavy forests a good running fire completely destroys all

vegetable life, but in chenas of less than thirty years' standing the fire is not strong enough to destroy the vitality of the roots, and in less than six months there is a fresh growth of jungle, which entails unceasing labour to prevent the young coconuts from being strangled and buried before they have a good hold of the soil. This labour is so indispensable and so persistently exacting, that, perhaps, the wisest, plan would be not to plant any chena land till it has stood a sufficient length of time to assume some of the qualities of forest.

LINING.—As soon as the fire has run, the land should be lined. There has been much difference in practice in the distance between the trees, the extremes being eighteen and thirty feet, The one is decidedly too close, and the other perhaps too wide. but the general practice has settled down into 25 feet, or seventy trees to the acre. It may not be an object of the very highest importance to have the trees exactly in their proper places, but it is not creditable to the skill and care of the planter if they are not. It will require a good deal of pains to lay down the lines, and carry them correctly, over a large field, but the result is worth all the toil and trouble taken. The universal arrangement is to plant on the square, that is, a plant at each corner. It would be a better arrangement to plant on the triangular principle. The leaves of a strong, quick-growing coconut tree are from 16 to 18 feet in length, and if they stood out at right angles with the stem each tree would shade a circle of from 32 to 36 feet in diameter, but the natural droop of the leaves takes 6 feet from this diameter, so that on a square of 25 × 25 the leaves of adjoining trees will cross each other, to the extent of from two to three feet; thus every tree is more or less interfered with by four others, standing at an equal distance of 25 feet but the diagonal spaces being 35 feet the leaves never meet across them. By planting so that trees in each line will break the spaces of the next, each tree will only be interfered with by two others at the distance of 25 feet, while the diagonal distances are reduced to 28 feet, across which the leaves will just meet, and not overtop.

HOLING.—The holes should be dug two feet deep, and three feet wide, or larger, if the plants are not seedlings; they should be filled in with the best surface soil to be found in the vicinity, but only for 18 inches, as it is important that the crown of the root should be six inches below the surface: the six inches left open will be gradually filled up level in the course of cultivation.

COCO-PALMS COMING INTO BEARING.

Tho only thing of real importance for some years after planting, is to manage the natural growth of the land, so that it shall neither interfere with the spread of the roots below ground nor of the leaves above, and to stimulate lagging plants with a dose of manure. It is neither necessary nor advantageous that the whole surface should be made clean and kept clean, for a good heavy growth of weeds and low brush keeps the soil in far better heart than a clean bare surface would. No heavy jungle root retaining its vitality should be allowed to remain where the roots of the coconuts have reached, but beyond this little is required for the first four or five years but to keep the natural productions of the soil within reasonable compass. After the fifth year the surface should he thoroughly cleaned, and all the remaining jungle roots either extracted or dealt with in some other way, to destroy their vitality. The object will then be to clothe the surface with natural grasses, fit to feed cattle. To this end, the surface should, after the first clearing up, 'be as little disturbed as possible: annual weeds should be pulled out by hand before flowering, and young jungle plants should be treated in the same way, but if they have a *dour* hold of the soil the hoe may be cautiously used. Cattle may be introduced as soon as the trees are out of danger from their nibbling, and the first use of manure should be to get forward such trees as have been making less progress than the general run of the field. The most beneficial way of applying manure to an individual tree is to mark a circle three feet from the stem, and beyond that open a trench, two or not more than three inches deep, and two feet wide; spread the manure fairly in the bottom of the trench, and return over it tho earth dug out; beyond this, and keeping the surface clear from every growth but pasture grass, nothing further is required till the trees begin to bear.

The length of time between planting and bearing will be owing to the soil and treatment. In tho very best lands the most forward trees will flower in the fifth year; but even in the very best land, the crops will be scarcely worth speaking of before the ninth or tenth year. After the tenth year, the annual increase of crop becomes rapid year by year, up to the twentieth, after which time all further increase will be due to cultivation and manure.

NATIVE MODE OF CULTIVATION.

Native proprietors always pay for the work of the first three years out of the natural fertility of the soil rather than out of their pockets: to their minds, the former is a fund of unknown amount to be realised as early as possible and in any form of draft; but capital that has once taken the form of colonial currency it is like skinning alive to place in a bank that only promises to return it with interest in the form of a deferred annuity, beginning in the ninth or tenth year, and gradually increasing up to the twentieth. They may believe in the promise of the bank, but they do not see how a present draft in the form of a bushel of kurakkan will deprive them of 150 coconuts they would otherwise realise within twenty years, and if they did, they would probably prefer saving 2/6 now to waiting all that time for 20/.

On land at all suited to coconut cultivation goiyas are always ready to undertake clearing and fencing, in consideration of being allowed to take a crop of kurakkan, of which the land-owner receives one-half, one-third, or one-fourth, according to the quality of the soil, and his own talent for making a bargain. The proprietor always finds the coconut plants, and generally arranges with the goiya for lining, holing and planting, to be requited by a portion of the land share of the crop. Sometimes a line of plantain trees are put down at ten feet apart between the lines of coconut the first year, and in other cases sweet potatoes are planted after the kurakkan crop, and, if neither of these plans is adopted, there is usually a second crop of kurakkan taken. By such means, a proprietor sometimes covers the cost of the land and the plants, and has money in his pocket when his plants are three year old.

It would take a chemical analysis to ascertain the amount of fertilising elements removed in a bushel of kurakkan, but an observing eye will certainly convey to a reflecting mind the idea that it is a very exhausting crop, not only in what it removes, but in its effects on the soil, hardening the surface and rending it impervious to air, light and moisture. Plantains will only be fruitful in good soil, which they rapidly exhaust; yet under native treatment they are rather an advantage than otherwise to a young coconut field, because there shade is very beneficial to the soil, and left to nature they grow almost all to trees, and very little to fruit. In the richest soil to be found in the island the single plant will in the

course of two years, surround itself with a hundred young stems, and the clump will extend to the diameter of four or five feet; the most advanced shoots are crushed up and strangled by their hopeful progeny, which extend their roots further; the circle still continues to spread, with the same crowding, till the various circles meet, and a whole field may thus die out in six or seven years without having in all that time yielded more than an occasional and accidental bunch of fruit. Sweet potatoes form a cover for the soil, that protects it from the influence of the sun, keeps down all other herbaceous growth, and renders it necessary to turn over the land, to reach the produce; they are not an exacting crop on the fertility of the soil, and probably do more good than ill to the land.

ENEMIES: WHITE ANTS AND CATTLE.

Forest or old chenas are not generally infested with white ants, but land that has been for any considerable time either completely or partially open is full of them; they are not partial to dry coconut husks, but they attack with great avidity such as are attached to young plants, and have been buried from six to nine months in the soil. When a young plant is transplanted, it requires a greater or less time, according to the weather, to throw out fresh roots into the surrounding soil, and is in the meantime supported and nourished by the husk. If, however, those insects take a fancy to it, they devour the husk in a few hours, and the plant inevitably perishes. The best way to deal with such land is to put down plants already two or three years old, but if it be necessary to plant seedlings, dissolve eight quarts of salt in a tub of water, thicken with fresh cow-dung, cover the husks with a coating of the mixture and let it dry before planting.

To get up a healthy coconut field it is absolutely necessary that cattle should be excluded, till at least the inner leaves are beyond their reach, as nothing dwarfs and retards the young plant so much as nibbling off the ends of the tender leaflets. The only security against this evil is a strong ring fence, that a bullock can neither break through nor leap over; such a fence is a necessity for the first few years, and an advantage for ever.

FENCING.

A fence of dead wood will in no case last for two years, and if the work be done by goyiyas it will be generally found to last their own time, and no more. A fence built with cabook stone

and mortar, with a brick coping, is a strong and handsome affair; but it is a pity that it should be so costly. A mud-wall is not a cheap fence to begin with, and is continually subject to accident. A great variety of plants are used for live fences, in different parts of the island, but every one of them is more or less subject to the objection, that they require care and labour to keep them secure. As care and labour cannot be dispensed with, in the case of any plants used for this purpose, the object is to find a plant that is not very choice n the soil it requires, that is of quick growth, and will become a secure protection, with the least possible labour. The Kaju nut plant combines all those advantages: it is of rapid growth, has no fastidious predilections as to soil, its growth can be turned in any desired direction, and a moderate amount of labour will make and maintain it a perfect security against the ingress or anything bigger than a hair.

The method of getting up such a fence is: dig up to the depth of nine inches a strip a foot wide along the proposed line of fence; in the earth thus broken plant the nuts two inches deep and six inches apart, in average soil the plants will be three feet high in a year. When they have reached this height more or less they should be bent over and intertwined along the line of fence. When the fresh vertical shoots, that will spring from the bent stems, are from two or three feet in length, they should be intertwined again, in the opposite direction. The process should be repeated with the third set of shoots, by which time the fence will be four and a half feet in height, and from that time the only further operation necessary is to cut the vertical growth, from time to time, down to the standard four and a half feet. Such a fence, so trained and treated, will be a perfect protection within three years, and will remain so far at least one generation.

BEETLES AND OTHER ENEMIES.

The next enemy in the order of its attack on the coconut plant is the black beetle. This insect attacks the plant as soon as they have substance enough to satisfy its voracity. It gnaws its way into the tender undeveloped leaves, in the centre of the head, on which it feeds. It sometimes—but very seldom, and that only on trees under two years old—cuts down the centre, and kills the plant; but they generally spare the life of the tree, for the sake of future feasts—indeed, except in very young trees,

they are rather a stimulant than otherwise. The trees that are specially palatable to them are always ragged and miserable in appearance, but, as they attach themselves to the most forward and thriving trees, they do not deform a field to the extent that might be expected. The common course of warfare against this insect is impaling it with barbed wires, when it is actually at work in the tree. It is, however, questionable whether this war on the perfect insect would be as effective as a campaign against the grub. Wherever there is decayed vegetable matter, there the grub is found in abundance, as a fat, white worm two inches long and as thick as a man's little finger, when near maturity, but presenting its specific character at all stages. In lessening this evil, two men will do more, if well directed in hunting for the grub, than twenty searching for the perfect insect in the trees. A whole district might be absolutely cleared of them if one system was adopted, but what is the use of science to myself, when my neighbours breed beetles enough to make their own trees and mine equally forlorn and beggarly ?

The bandicoot rat follows cultivation, the porcupine retreats before it, but both are equally dangerous to a young coconut field ; the only way of dealing with either is to trace them to their dens and destroy them there. It is exceedingly nasty to find trees of from two to six years old eaten right through their stems, close to the ground; but hunting is the most congenial occupation of man, wild or tame, and the offer of a handsome reward will set a whole village on the alert—men, boys and dogs.

The red beetle is by far the worst and most deadly foe of the coconut tree : it becomes liable to the attack of this insect as soon as it forms stem, and is not safe till, or even some time after, it comes into bearing. The black beetle in its perfect state feeds on the young undeveloped leaves ; the red beetle in its perfect state has no organs of nutrition, and feeds on nothing, but its grub devours the very substance of the tree, and in many cases the fall of the head is the first intimation of its presence ; its ravages are so extensive that some properties have been known to lose one-third of their trees within the first ten years. The beetle deposits its eggs wherever it finds a wound or a crack in the smooth, hard, outer rind. As soon as the grub is hatched, it commences to eat its way into the centre, with a course upwards and inwards, enlarging the opening as it grows. As it approaches to maturity it returns to the surface, and rolling

itself in a cocoon of fibre it awaits maturity, and it generally leaves the outer rind as thin as writing paper. The beetle has no difficulty in making its way out; it sometimes, however, cannot do so, and perishes in the tree. The only really safe measure with a tree into which the grub has penetrated is to root it out and burn it to ashes. It is sometimes cut out, but this only appears to save a tree, the stem of which has become too hard for its operations. Although little or nothing can be done in the way of remedy, much may be done for prevention. The coconut stem expands within a sheath of embracing leaves supported by strong fibrous webs that only slowly yield to the pressure from within. At the time the young stem emerges from the ground it is very tender and easily injured: nature has therefore provided that, at this period, the sheath of leaves and webs shall cling to the stem with a persistent tenacity, unknown at a more advanced period of growth; the leaves do not fall off, but rot off, and so long as there is a sound fibre it sticks. If nature has made a mistake in this direction then the cultivator is justified in lending his aid to get rid of an encumbrance; but if Nature does nothing in vain then the artificial removal of the ragged and decaying sheath is rather to thwart than to aid her purpose. In removing a dry, tough fibrous matter, probably with a blunt catty, there is great danger of inflicting a wound; and even if this be avoided the laying bare to the weather of the young tender stem, before the outer rind is sufficiently hardened and compacted, causes cracks, that are for some time equally dangerous with an artificial wound. To lay it down as a rule, that no part of the tree above ground is to be subjected to any artificial process whatever, will be an almost absolute protection against the attacks of the red beetle, as it can no more get its eggs within the ripe rind of a coconut stem without wound or crack than it could get them into a jakwood plank. Scores of instances might be recorded where till the trees were come into bearing a red beetle was never seen, but no sooner was the land cleared and the trees trimmed than it made its appearance, and became very destructive. On one property the trimming system had been carried on for years, till, indeed, more than one-third of the original plants perished, before the estate was ten years old, and they were going at the rate of three trees weekly. The work of trimming was stopped for the reasons offered above: the loss of trees continued for some time afterwards, but at the end of six months it had entirely ceased. On another property, beetle-men had been employed for ten years, and trees were being constantly lost: from the day that the "beetlers" were

discontinued two trees perished within the month, and not another was lost in the subsequent seven years.

CULTIVATION WHEN TREES ARE BEARING.

The treatment of coconut palms in bearing is nearly uniform among natives: to take all that Nature yields and return nothing. Natural manuring goes on, to a greater or less extent, around every dwelling; nothing else is done in the village gardens from one generation to another. There are vast numbers of properties in native hands, ranging in extent from five to one hundred acres. Some of these are kept in pretty good order, as far as keeping the land clear is concerned; others are neglected, some have been swallowed up in jungle. On properties over 100 acres in extent, the systems are almost as various as the men who manage them. The practice most common is to keep the surface clear of jungle, and encourage the growth of natural grass. As many cattle are generally kept as can be sustained by the pasture, and the manure is returned to the land, in some cases, by tying the cattle to the trees at night; in others by enclosing them nightly in movable pens. When they are housed in sheds, the manure is generally supplied in holes dug near the trees, or in shallow, circular trenches, dug round them. Most who have a market for the fallen leaves, husks, and shells avail themselves of it. The most common way of disposing of those things, when there is no market, is to burn them, and either mix the ashes with the cattle shed manure or leave them on the surface, where they are burned. Some few properties are periodically ploughed, but this operation is not common in estate cultivation; in light sandy land, frequent stirring of the surface is not beneficial; but strong heavy soils, with a tendency to harden on exposure, cannot be ploughed too often.

On one estate in the Western Province the following is the mode of management. The whole crop of nuts is manufactured into oil on the place. The cattle kept on the estate have their will of the poonac tubs. When the price of this article is 5s. per cwt. or upwards, the remainder is sold, and the money received for it is expended on the purchase of the bone dust; when the price is low, the remaining poonac is turned into the cattle sheds. A trench, one foot deep and three feet wide, is opened in every fifth line of coconuts, into which all the weeds that grow on the land and all the droppings of the trees are thrown twice a year, and when they are full they are covered up, and a fresh trench is opened in the next line. The

husks are all carried back to the land and packed in trenches, nine inches deep and three feet wide between the lines and covered up. About 100 head of cattle are kept on the estate, from 40 to 50 of which are required for work, the remainder being breeding and young stock. The cattle are housed nightly in spacious sheds into which a fresh layer or litter, collected from the "deniyas" on the property, is daily laid. At the end of six months the sheds are cleared out, and the manure spread over the face of ten acres—more or less—and dug in. When bone dust is used, it is sown over the same surface, at the rate of the three hundredweights to the acre, and dug in along with the cattle-shed manure. This system was introduced twelve years ago, when the property was in its nineteenth year, and has been improving and hardening for eight years. The results on the crops in that time are an increase of eighty per cent. in 1868, and an average of 50 per cent for the first eight years, though three successive years of drought caused a falling-off of 14 per cent from the crop of 1863-64. The surface of this estate is almost a dead level, and the soil a very light sand, free and kindly, but exceedingly poor. It responded largely and rapidly to the application of manure, but the effect only lasted for three years, in the case of cattle-shed manure; guano has been found utterly ineffective, but bone-dust is highly satisfactory, less for its immediate effects than for its longer operation.

Every 40 cubic yards of cattle-shed manure contain the elements of 3,000 ripe coconuts, delivered within 4 years; from five to six hundredweights of bone dust is the equivalent, but it requires seven years to complete this return. Other manures have not been applied in this instance, but, if other planters will institute a like system of observation and publish the results, the exact value of all the different kinds of manure used might be made public property and coconut planters would cease to work in the dark. It would be a vast advantage to them, if they could distinctly ascertain from recorded facts that on a given soil such and such quantity of any given manure would give within a certain time a certain number of coconuts. Say that I expend £70 in making and applying 800 yards of cattle shed manure. I gain within four years £180, or upwards of 150 per cent. on the transaction. I expend £4 on the purchase, transport and application of bone dust: my return within seven years will be £9 or 125 per cent: over 20 per cent. per annum.

We will close this sketch with a theory of coconut cultivation drawn from the doctrines of agricultural chemistry. The fertility of

a soil for any given purpose consist in the quantities and proportions of the soluble bases it contains, and in a lesser degree on its mechanical state, and the regular supply of the necessary amount of moisture. More or less of the fertilising elements in the soil are removed with every product that leaves a residue after burning. Coconut oil burns out without any residue: therefore the removal of the coconut oil from land takes away no part of its fertility. It follows that, if only oil be removed from a coconut estate, and all the other products of the soil be restored in one form or other, the fertility of such land will never be permanently impaired; and another inference is necessary, namely, that every particle of fertilising matter brought into such land must increase its permanent fertility.

If this be the true theory, then the property from which only oil is removed has an important advantage, and may be kept up and improved at considerably less cost than those from which other products of the land are likewise removed. In the one case, the fertilising elements of the land are kept in constant circulation without diminution, while in the other a portion is abstracted in every gathering. On one estate the crops may be fairly expected to increase in exact proportion to the amount of foreign fertilising matter brought into it: in the other, they may with equal fairness be expected to diminish, unless an equivalent of foreign fertilisers is introduced. It is possible to give examples, but "comparisons are odious," as Dogberry remarks.

COCONUT CULTIVATION.

THE REASON FOR WRITING.—As my opinions on coconut cultivation are still in advance of the common practice, I propose, in a series of short papers, to do justice to my own views, in the faith, that, so far as they are consistent with sound principles, they will gradually be accepted by the growing intelligence of those interested in this product, which, so far as the native industries of the Southern and Western Provinces are concerned, holds the first place. I have already opened the subject by a slight sketch of the commencement and progress of coconut estate cultivation, and I now proceed to treat the subject from the beginning.

SOILS.—There are two kinds of soil on which coconuts refuse to grow to any profitable purpose, namely, thin washed gravels overlaying solid cabook and stiff clays, both of which should be avoided; they will never pay for the labour; otherwise they are not particular. The richer the soil, they will grow the quicker and bear the earlier; and the heavier and, as a rule, the longer it takes to bear, the smaller will the crops be. The best of all soils for coconuts are deep alluvial loams, on the banks of rivers, subject to floods that overflow on the neighbouring lands; in such situations, the crops are enormous; indeed, a few acres of such land is a fortune to its owner, and, as the soil is particularly inexhaustible, it may go on for a century bringing in annually an income of R300 or more. Such pieces of land are generally small in extent, and widely apart. The next quality of soil is the brown loams, and they are only found in certain districts, and seldom extend into the higher uplands, where cabook gravel with varying proportions of loam prevails, and this is now almost the only description of land to be obtained. A loamy sand is a good coconut soil, and, with scientific cultivation, is only inferior to the alluvial and brown loams.

LAY.—The lay of the surface is an important factor in successful coconut cultivation; other things being equal, the nearer the approach to the level the better. Steep hill-sides are always poorer than neighbouring flats, and they become poorer from the base upwards,

while a flat hill-top is always better than the steep sides. Darwin's work on earthworms describes the cause of this scientifically, and I need not bring my rushlight into the presence of a flambeau.

NURSERIES.—Eight months before the plants are wanted for the field, a nursery should be put down with 50 per cent more seed nuts than the number of plants needed, because there are always a greater or less number of the nuts that do not germinate, and all that have not germinated within five months should be rejected, as likely to carry the same slowness of growth into the field; and to this cause, chiefly, may be ascribed the inequality of the trees years afterwards, when there has been no difference of soil or treatment to account for it. The selection of the seed-nuts is is an important affair, and should be done with great care. The best way is to select the trees from which the seed nuts are to be taken; and the rules to go by are—a mature healthy tree in heavy bearing, the nuts should be medium size, with thin husks, and should be ripe but not dry, as feeble plants alike result from insufficiently ripe and from over-ripe nuts. The coconut does not come true to seed; indeed, it would be difficult to find, in any field, two trees bearing nuts that are exactly alike, in colour size and thickness of husk; but there is a better chance of getting a good type from a good tree than from taking seed indiscriminatingly. The ground for the nursery should be dug six inches deep, and formed into beds four feet wide, by removing three inches of the soil and laying it on the intervening spaces; then pack the nuts as close as possible, in the beds, with the stalk-end up and return the earth dug out, to fill the spaces between them, covert he beds with straw or grass, and water, when there are four or five days without rain.

LINING.—The clearing should be completed by the end of February, and the lining and holing begun with the first March rains. Experience has settled 25 by 25 feet as the proper distant. Great care should be taken in lining, not that a foot or two one way or another will affect the ultimate crops, but no one with good taste can wish to leave behind him a lasting memorial of careless work, when a little more trouble will record his skill for a century.

HOLING.—Coconut holes cannot be made *too large*, say 3 by 3 by 3 feet, and they should be filled in for half their depth, with soil from the surrounding surface. It is important to give the plant

the means of a fair start, and 18 inches of loose rich soil, below and all round it, is the best available means to that end; indeed a plant so treated will gain several years on one placed in a one-foot hole.

FENCING.—The next operation, or rather an earlier one, is a fence sufficient to keep out cattle. There is generally enough of wood on the ground to form a strong rough fence that will serve the purpose for three years, and the planting of a live-fence may be deferred till that begins to fail or till there is leisure to attend to it. There are many plants that may be used for fencing, but that in most common use is *erandu*, the efficiency of which depends entirely on the maintenance of cross-sticks tied to each plant, and that requires to be renewed, at considerable expense, at least once a year. Sapan is straggling and unreliable, and is given to resentment when any attempt is made to train it. The *bide-a-wee* thorn would make an excellent fence, but I am not aware that it has ever been tried, or even that it will submit to training, more than to external meddling. The kaju makes a very effective fence, in the Kadirana cinnamon estates, but like all other live fences, it needs training and labour to keep it in order. The fact is that plants in great variety may be trained into a good fence, but all require labour and care.

SECONDARY CROPS AND GOIYAS.—I have no objection to growing secondary crops on a young coconut field; but the value of the crops should cover the cost of labour at current rates, restore (in the shape of manure) the fertility they take out of the land, and yield the owner some return of profit for his time and trouble. Those conditions are not met by the usual goiya course—kurakkan, cassava and sweet potatoes. These products have only a local value, and are only used by the poorest of a poor population. The kurakkan crop is the most exhausting that can be taken off land, consuming more of the nitrates and phosphates than many other products of much greater value would do; and if cassava and sweet potatoes are less detrimental to the soil, their money-value is hardly worth cultivating. By the employment of goiyas, the land-owner saves the payment of felling and clearing his land, under R10 per acre on the average; he receives a few rupees per acre as the land-share of the crops, and he need be nothing out on account of cultivation for the first two years, and all that he gets will seldom aggregate R30 per acre.

Per contra, he loses an unknown measure of the freshness and fertility of his soil, which, because it is unknown, he never counts; yet it is a real element in the account. Were I interested in the question, I would submit a sample of kurakkan to a chemist and thus ascertain the money-value of the elements it removes, but, as I am not, and never intend to be, I am not prepared to go to the expense. It would be more tolerant of goiya cultivation if they would grow some other crop than than the everlasting kurakkan. Dry chillies, for instance, are worth R25 per cwt. and average jungle soil will certainly yield 3 cwt., most probably more, whereas the money-value of the best kurakkan crop is under R30 per acre. If the proprietor starts his estate with capital enough to do his cultivation full justice, there are many ways in which this can be done with greater profit than employing goiyas.

SECONDARY CROPS AND ALTERNATIVE TREATMENT.—As secondary crops, such products as croton and anatto would be much more profitable than goiya culture; the former sells at 70s to 80s in the London market, and I believe there is always a paying market for the latter, though I found no quotation in the *T. A.* In fact, there are many things that could be grown with profit on the land, and with small injury to the coconuts, during the long years the cultivator has to wait; and if some of the profit be expended in fertilisers for the secondary crops, the coconuts will partake. The only thing to be avoided in such case is growing anything running up to shade the coconuts. If it is preferred to devote the whole strength of the land to the coconuts and bring them into early bearing by forcing, the best way is to sow the land with guinea-grass, stall feed as many cattle as will eat it, and keep putting the manure so made to the most feeble and lagging trees in the field. By this means the trees may be brought into heavy bearing years earlier than they would yield a nut if left unaided even by tethering cattle on the natural pasture, so that they cannot reach the young trees; and by digging in the droppings near the plants, much may be done in hastening bearing. Such operations would not, indeed, bring any fresh fertilising matter into the land, but, by concentrating such as was already there and placing it within reach of the roots, the tree would be strengthened and stimulated to push out roots more rapidly in search of further supplies of plant-food, resulting in quicker growth and earlier maturity. I would be glad to convince every owner of a young coconut property that it is more to his advantage to treat his trees generously and get them into

bearing in seven or eight years than by grudging and withholding a very moderate annual expenditure, having the trees straggling into bearing over the whole ten years between the tenth and twentieth, and that twenty acres fairly treated throughout will, at ten years' time, be a more valuable property than one hundred that has been starved and neglected. It has been sadly against a progressive improvement in the cultivation of coconuts that the proprietors are almost to a man traders, clerks and professional men who have thus invested their savings, but who acquire no knowledge of the habits and requirements of the plant.

ENEMIES OF COCONUTS: WILD PIGS.—If there are wild pigs in the neighbourhood of newly-planted coconuts, they are very destructive, and I know no effectual means of circumventing them. A secure fence would do, but I have never seen a sufficiently secure fence. Night-watching is of little use in dark nights, while battue-hunting is not easily organised, and is seldom if ever effectual in either exterminating or driving the herd away from the locality. This danger is however, passing away as the country is opened, though the herds often linger in their old haunts as long as they have cover. It is only within the first six or eight months that the plants are liable to this evil.

WHITE ANTS.—White ants are very destructive to young plants for the first year or till the roots have so far penetrated the soil that the plant is independent of the nourishment derived from the husk. Many things have been tried as remedies with more or less success, but the only thing that effectually settles them is arsenic. The difficulty is in the application of the minute quantity necessary: half-an-ounce of arsenic would poison all the termites in a hundred acres if they could be induced to partake of it. From Queensland we are told that a paste of floor, sugar and a small quantity of arsenic distributed about their nests will clear a whole neighbourhood. No doubt the smallest atom of the poison will suffice for a single ant if it can be induced to take it. This information was accompanied with a piece of natural history that, if true, would render dealing with this pest extremely simple. It is maintained that white ants eat the dead, so that when you have succeeded in poisoning one, you have provided for the destruction of a thousand. I would recommend the following process in the case of coconut plants:—Take a tub, fill it nearly full with fresh water, dissolve in it a quarter of a pound of sugar to each gallon of water,

add flour till the mixture is of the consistency of whitewash, add two grains of arsenic for every gallon of water. Mix thoroughly and keep stirring while the coconuts are being dipped in the mixture. Lay the nuts in the sun to dry the thin coating of the mixture that adheres to their surface, and then plant. There is no doubt whatever that the insects will be destroyed if they eat the mixture, and it will be impossible for them to reach the coconut without doing so.

CATTLE.—Cattle eat the leaves of young coconuts, and for the first three years must be absolutely excluded, or securely tethered, out of reach of the plants. They are out of danger when the animal can no longer reach the lately-developed leaves, and they do not meddle with the older growth.

PORCUPINES.—Porcupines are not common in coconut districts; but where there is even one in the neighbourhood of coconuts that lately formed stem, it is very destructive. Its mode of operation is to eat through the stem and commence on a fresh tree on each nocturnal visit. Wherever it puts in its appearance, it should be hunted down and killed at any cost.

KURUMINIYA OR BLACK-BEETLE.—When the coconut has tolerably thriven during the first year and has any available cabbage in the heart the black-beetle commences operations. He bores his way through the outer covering of mature leaves, gorges himself on the tender undeveloped heart, and then departs till he is again an hungered when he returns and effects a fresh entrance. When he finds a tree especially to his taste, he returns so often, that, when the cut leaves come out, the foliage has a most ragged and forlorn appearance. All this work is done in the night, and he is very rarely found in the tree during the day, but, when he happens to delay his departure till daylight, he remains in his retreat all day, and if discovered, may be slain there with a barbed wire. I have lately seen kerosine oil tried, but without any effect. The insect cares not for stinks, it cares not for smoke, it cares not for anything man can do to circumvent it. The only way I know of reaching this pest is to hunt up and destroy the grub in every dung hill, every accumulation of decayed vegetable matter or rotten tree in the vicinity. A specially favourite breeding place is an old heap of cinnamon scrapings on estates, where a score of great white grubs may be found often in a cubic foot of this matter.

RED-BEETLE OR KANDAPANUWA.—The next foe that attacks the coconut is the red-beetle. Unlike the large black species, it has no alimentary apparatus whatever in its perfect state, the sole business of that stage of existence being the propagation of its species, and its breeding ground is the tender stem of the young coconut tree. It is furnished with a stiff horn in front, with which it is supposed to puncture the outer coating of the stem, and deposit one egg in every opening so made. As soon as the grub is hatched, it begins to eat its way inwards upwards, enlarging the opening as it grows till it attains its maturity as a grub. It then returns from the centre of the stem, and just within the outer rind, which it reduces to the thickness of foolscap, it wraps itself in a cocoon of the fibre of the steam and there awaits transformation; when that occurs it is easy for it to break through the thin partition that divides it from the outer air. The coconut is in danger from this insect, from the time it shows stem till it begins to bear. The body of the young stem is a mass of matter of the same nature and consistency as the heart of a cabbage stalk, which hardens from the surface inwards. Nature has provided for the protection of the tender young stem in the close fit of the imbricating leaves which enclose it on all sides, and retain their hold till they rot *in situ*. The red-beetle cannot penetrate the leaf-imbrication, and, when the older ones decay in the course of nature, the stem has become too hard for its operations. A tree here and there may be lost from an accidental wound or from some defect in the fitting of the leaf-sheaths, but it is only where the good taste of the planter has impelled him to trim the leaves that any serious damage has been done to a field. All the leaves should be left on the tree till Nature disposes of them at her own time and in her own way. Nothing that can be done to a coconut tree above the ground can be anything but injurious. As soon as it is discovered that the *kandapanuwa* has effected an entrance, the tree should at once be rooted out, chopped up and burned, as there is no more hope for it, and it is not well to leave a breeding ground for so formidable a foe.

RATS.—When an estate is in bearing, it often becomes infested with rats. They attack the half-grown nuts, make a hole through the husk and shell, and, when they find a tree with fruit to their taste, they appropriate its whole produce. The native cultivators put a ring of tar round the stems, which they say is too smooth to give them a foot-hold in climbing, and they sometimes keep a donkey

in a field, whose braying is supposed to frighten them to the extent of driving them out of hearing of the awful sound. The tar dodge may possibly be effective, but the trees should all be cleared of rats in the first place; every tree in the field should be tarred and all other means of getting up removed, for they can freely pass from tree to tree, and, when they have sufficient food and drink and the materials of a comfortable nest on the spot, thy have no occasion to visit *terra firma*. As for donkey braying, it is probably one of the myths to be found in the folklore of every land. It is a misfortune of the coconut planter that all his foes are nocturnal in their habits, so that in dealing with them he gropes in the dark. Would the rat only come out and work in the day, the infected trees could be watched and a charge of sparrow-shot bestowed on the robbers. Attempts have been made to poison them, but, while they have their will of the young coconuts, the most savoury morsel will not tempt them.

LOCUSTS.—The locust is so rare in Ceylon that it is hardly worth mentioning, but it somtimes appear in small numbers, and the coconut-leaf is a favourite. They devour all the leaflets, leaving the bare midribs, so that, when they have done with it, it has a very wintry look.

GRATITUDE OF THE COCONUT FOR FERTILIZING MATTERS.—On all soils, except the most fertile, the presence of a human habitation in a coconut field can always be distinguished at a distance by the superior height and luxuriance of the trees that surround it. The native accounts for this appearance by saying that the coconut loves the sound of the human voice. This is on a par with the old theory of the water rising in the pump because nature abhorred a vacuum, which held its ground till it was discovered that nature's abhorrence of a vacuum was only thirty-two feet deep. The bulk of the Sinhalese people have not yet discovered that whistling-jigs to a millstone would be quite as useful as singing the gems of vocal music to a coconut tree. The true cause of the better thriving of the trees round a dwelling is natural manuring. Where a family and their usual stock of domestic animals reside, there are daily droppings of fertilizing matter within the circle they frequent, decreasing from the centre outwards. The trees nearest the house are always in bearing years before the out field, and they always continue the most productive throughout, or as long as the house remains inhabited. Put a set of lines in the most backward part of a field,

and improvement begins at once. This proves the gratitude of the coconut for any help, however small, that either by accident or design is given to it, and suggests hastening the profitable period by artificial means. On most places, a few trees near the house flower in the sixth year, some even in the fifth, and yield a fair crop in the eighth, whereas those that have had no manure do not begin before the tenth year and struggle into bearing, one by one, up to the twentieth, while the best that the natural soil can do is not attained before the twenty-fifth. There is not within my experience any other plant that so quickly and fully responds to fertilizers and much or little the result is proportionate. If one tree favourably situated can bear a crop in the seventh year, a whole field may be made to do the same, the question being: "Will it pay?" To answer this question the cost of opening a coconut field must be analysed.

NATIVE PRACTICES: CALCULATIONS OF COST.—By goiyas, the field will be cleared without money spent; and in a very favourable case the land-share of the secondary crops will cover the cost of lining, holing and planting and the owner take over his field free of all cost to him, except the fee simple of the land, and the accumulated interest on it. The field is then left to grow up in jungle for three years, when there is the alternative of clearing the jungle or letting it grow on, and finally smother 90 per cent of the plants, whereas the reclearing of the jungle, if done in the sixth year, will probably save 50 per cent. The field may then be left till the most forward trees begin to flower, say in the twelfth or thirteenth year, when the final clearing takes place; and in favourable cases 40 per cent of the trees will be alive, and 10 per cent of the these in bearing, the remainder being of all sizes downwards, in the event of steady cultivation being then carried out, in keeping down the jungle and replanting the vacancies. The annual expense per acre will be R12, and only about the twentieth year will the field be yielding enough to cover its annual cost, while 10 per cent of vacancies will still exist. Thus the absolute cost in money of bringing coconuts into bearing, in the most slovenly and desultory manner, will be R120, R30 of which will be recouped by produce up to the twentieth year.

EFFECTS OF LANTANA.—I have assumed that the land dealt with is of average quality, and that the indigenous jungle alone has to be treated; but if lantana obtains a settlement in the third year

and is left untouched for the next three, not one coconut plant will survive till the seventh year. When lantana gets into a clearing, it thoroughly masters and keeps down every other growth that it overshades, but any tree that has got above its usual range of seven or eight feet is safe from being smothered. However, its growth may be retarded by the struggle to obtain food in the soil against such an active and greedy foe. The presence of lantana in a clearing guarantees the extermination of every other member of the vegetable kingdom that depends on the first eight feet in space for its air, light and sunshine.* It has rather bothered the old school coconut planters.

CALCULATIONS OF PROCEEDS.—The chances are that under the above system the yield of average soil will be 1,000 nuts per acre, worth (say) R30. There is R90 to make good, the interest on which, at 10 per cent, is R9; the current expenditure is R12, and there is R9 over to be deducted, if we value the proceeds at R30. Supposing the annual increase of proceeds to be R5, it will take five years to rub out the R90 that stood at debit in the twentieth year. Thus in the twenty-fifth year the place is clear, and the annual average income per acre will be thenceforth R38 per acre, so long as the price keeps up to R30 per 1,000, and this calculation drops all the back interest on the original cost as well as on current expenditure, from the twelfth to the twentieth year, which, if taken into account, would leave from R60 to R70 to be made up before the property was thoroughly clear of debt. This is by no means a fancy sketch, but almost the exact history of more than one property that I have had under my own observation during the whole course of their existence.

ANOTHER SKETCH.—I will now give another sketch of what happened on the adjoining lot to one of the properties described above. The land was felled, cleared and planted, but the jungle got up again so rapidly, that, at the end of twelve months, it was ten feet high, and the wild pigs have done "their worst" with the plants—only four plants remained in the whole field. This was rather discouraging, but the proprietor had a good deal of latent pluck, and the second year went to work on a new plan. The jungle was regularly rooted out, at a cost of R20 per acre, and planted with cassava, to which the pigs more earnestly inclined than to the coconut plants, and about 70 per cent were got out of this danger. The vacancies were regularly supplied twice a year, but at the end of nine years they still amounted

* "The survival of the fittest.—ED."

to 10 per cent. The meantime continual war was made against jungle and lantana, and when the trees were four years old, the pasture grass was mid-leg deep. Cattle were then introduced, but, as many of the plants were not out of danger, they were tethered out of reach and shifted as required. Before the end of the fifth year 10 per cent of the plants were in flower and three-fourths of all that had been treated with cattle-manure were in bearing before the ninth. Further deponent sayeth not, as the ninth year is not yet ended. The trees that began on flower three years ago have now crops of from 50 to 150 nuts; allowing for all accidents, they will average 80 per tree, or 5,600 per acre, which at R30 gross produce R180. I think the proprietor would have refused me his permission to tell in Negombo and publish in the street of Colombo that he had expended about R200 per acre on coconuts before obtaining any appreciable return. It would have blasted his character as a prudent and intelligent person for ever, unless accompanied by the further fact that every penny principal and interest would be returned before the twelfth year, leaving a very valuable property in his hands. The only thing that has been brought into his property by way of manure was one-third of a ton of quicklime, at a cost of R7·50 per acre. As everything done of this property was experimental, the expense would be very considerably reduced by the knowledge acquired of what to do and how and when to do it. It may be added that the land in question is very much above an average quality, which, if favourable to results, greatly enhanced the cost There is a portion of this property that has never got any cattle-manure, but in every other respect the treatment has been the same, and there is no outward difference in the soil; yet there is a marked difference in the trees, not one of them being in bearing and many not even so advanced as to show stem, As their wants cannot be supplied from internal resources, the proprietor states that he will give each of them 12 cents worth of poonac at once and repeat the dose yearly till uniformity is attained.

How an Old Estate was Treated and How it Responded.—Having thus told what has been done in hastening the maturity of young coconuts in good soil by manure made on the spot from the natural produce of the very land on which the plants stand, I proceed to relate what was done with trees twenty-one years old on very poor sand. The estate in question at twenty-one years old yielded a crop averaging 13½ nuts per tree, and that was the largest it had ever given. The copperah was worked

up on the place; there was a large stock of half-starved cattle, and a stock of pigs were kept; but all this had got the crops no further than 13½ nuts per tree. At this stage, a new manager took charge, and, after due study of the situation, he submitted a scheme that added about 10 per cent to the average annual expenditure. Some of the points were strongly opposed by the agent, but, being a reasonable man, he finally gave in to the reasons adduced and sanctioned the complete plan. The pigs were got rid of, as their local value was then only about 25c. a stone dead weight; one-third of the cattle stock was sold off by auction without reserve; the whole remainig stock were allowed the liberty of the poonac tubs, and a shed was constructed roomy enough to hold the whole comfortably. There were extensive "deniyas" on the property overgrown with panferns and coarse grass, and four boys were sent with small single bullock-carts to cut and bring this stuff to the cattle shed, and spread it over all. Thus in the course of six months there was a depth of from two to three feet of excellent manure. At the opening of the monsoon rains, the cattle were moved to a fresh shed, and the manure carted out and laid down at the rate of two and a half cubic feet to each tree; it was then scattered equally over the surface and dug in with mamoties. The improvement of the trees and the increase of crops that followed this treatment was marvellous. All the manure that could be made on the estate, however, was a mere drop in the bucket; such a manuring only told on three crops, while it would have taken 12 years to go over the estate. Still even this was sufficient to cause a steady annual increase of crops from 13½ up to 21 in six years. After some trouble, permission was granted to try steamed bones, and in the six years one ton was used with such satisfactory results, that two tons per annum were allowed for the next four years, with the result of 33⅓ nuts per tree in the eleventh year. Shortly afterwards this estate was sold to natives, and six years later the crops were said to have fallen off to 12 nuts per tree. The whole cost of manuring during those ten years aggregated R1 per tree and the value of something over R3 thus recovered giving a return of 300 per cent on the outlay in four years, and there is not the least doubt that five times the amount expended within the same time would have given equally satisfactory results.

THE COCONUT TREE A CHEMICAL APPARATUS.—I look on a coconut tree as a chemical apparatus, for turning carbon, oxygen and

hydrogen into oil. Those elements are not counted in estimating the fertility of soils; indeed it is probable that plants derive their whole supply from air and water. If this is admitted, it follows that no quantity of oil removed from a given area of land in any way tends to impoverish the soil. But the coconut tree cannot make oil without a proportion of other elements that it combines; the process requires nitrates, phosphates and alkalies, to complete the operation, and these it must obtain from the soil. Extract the oil and return all the other products of the tree to the soil it occupies, and there will be no diminution of the average yield of oil, as long as the tree lives in health. Increase the supply of nitrates, phosphates and alkalies in the soil, and in due proportion the tree will produce more oil, while the fertilizers introduced are a permanent gain.

Replacing Fertility Removed: Poonac as Manure.—The coconut planter, who desires to maintain the average crops of his property, will do well to ascertain the average of the fertilizing elements removed in a given number of nuts, and set aside such proportion of the price as will replace them. The sure way is to manufacture his oil on the spot and retain the poonac; but sometimes it appears more profitable to sell the nuts as they stand than to extract the oil and sell it separately, because the cost of manufacture, with the primitive apparatus he must employ, is greater than with proper machinery; but if he knows exactly how much nitrates, phosphates and alkalies are in a candy of copperah, and their prices, he will know how to proceed in his purchase of fertilizers so as to maintain or improve the condition of his land. There may be better forms of fertilizer than poonac, but 140 lb. of poonac will, as a rule, restore all that is carried away in 1,000 nuts; and when this quantity can be obtained for R1·25, there is no cheaper way of giving back what is taken away; besides, it has an advantage over every other form of manure in supplying all the elements of the coconut in the exact proportions required, while the loss, by putting it through the alimentary apparatus of a cow, is very small.

Manure made from the Coconut Field; Manuring should begin early.—Manure made by cattle fed on the grass of the coconut field adds nothing to the general fertility of the land; it merely removes it from one place to another; but while the plant is young, and only commands with its roots a small pro-

portion of the space assigned to it, the placing of it within reach of the roots in this form is of high importance to its rapid growth and early bearing. It is not the amount of food thus placed within its reach that limits the good done, the roots are stimulated to push out further into the soil, and thus acquire a wider feeding-ground. Small doses frequently repeated are far more beneficial than greater quantities at long intervals; and in every case it should be buried under at least two inches of soil. I would recommend, in putting out the plants, to dust a couple of handfuls of quicklime into and round the hole, and I would give each at the same 1 lb. of poonac. A good start is half the battle, and what is once gained should never be lost for want of a little stimulant. I cannot expect the tree to yield me an annual revenue of from two to three rupees, unless I use every means in my power to establish its constitution; and in the whole range of vegetation, I believe, there is no plant that will do so much for itself with so little help. I would spend 50 cents per tree in building it up during the first seven years, after which time it will give a return within four years of three nuts for every 5 cents worth of manure given. There is no practical limit to the yield: I have known one tree that for a series of years bore 400 nuts; I saw another a few days ago, that was very little behind it, and I have known many individual trees that regularly yielded from 200 to 300. In such cases there is, no doubt, much in the individuality of the tree and special suitability of the soil; but my contention is that any tree that bears a small crop in any soil may be made to bear a large one, the only difference being that a good soil gives a good crop without assistance, while a poor one gives a poor return, but the one will respond to manure as readily as the other. The same amount of manure will result in the same addition to the crops, whether the trees to which it is administered have previously been bearing ten nuts or fifty per annum. The weaker tree may appropriate some part of the manure to build up its strength, and, if the soil it occupies be deficient in the capacity of retaining moisture, it may be unable to appropriate at once the food within its reach, but the manure once in the soil will tell sooner or later.

REGISTER OF TREATMENT BY THE COCONUT STEM: TREATMENT OF A SINGLE TREE AND RESULT.—The stem of a coconut tree on poor land forms a complete register of the periods at which manure has been administered, the effects it produced and the time

during which it operated and became exhausted. It contracts under the pressure of want, expands when fed liberally, and again contracts when all the food is used up. There was a tree that had stood for twenty-five years on sand so poor, that not a blade of vegetation was ever seen within twenty feet of it; the stem, over one foot in diameter at the surface, gradually diminished upwards, till at the five feet of height attained, it was less than four inches and the length of the leaves was about thirty inches. In very truth, no more wretched specimen of a still living plant could have been conceived by the mind of man, and it was only for the sake of proving the theory that its treatment was undertaken. Twenty pounds of poonac and five pounds of steamed bones were mixed and sown broadcast in a circle twelve feet in diameter and dug in. It began to grow vigorously at once, and each fresh leaf that expanded was an increase on the length of its immediate predecessor till at the end of twelve months they reached 15 feet; at eighteen months it produced its first flower and was again manured with five pounds of poonac and two pounds of bones; at thirty months it began to give crop, and the top was so heavy that there appeared some danger the small part of the stem giving way, but this did not happen and for the three succeeding years the same dose of poonac and bones were given. At the end of the fifth year it was a handsome vigorous tree with the stem immediately under the leaves over one foot in diameter with a crop of from 60 to 70 nuts, while the aggregate of previous gatherings was over one hundred nuts. I have only to add that the cost of these results was 75 cents.

CONFIDENCE OF SOME IGNORANT PEOPLE AND ASSERTION OF SCIENTIFIC TRUTH.—I felt much hesitation before deciding to tell this story as there are hundreds of men in Ceylon who consider themselves no mean authorities on coconut culture who will without further ado pronounce it an absurd impossibility. There are truths that science has made common property, but which few coconut planters have yet asserted their right in, or indeed become aware of their existence. How few of them know that 187 lb. of poonac contains all the elements there are removed from the soil in a candy of copperah (560 lb.)? How few of them know that the poorest soil may contain some of the elements of fertility that the plant cannot assimilate from the absence or deficiency of other necessary elements? How few of them know that a very slight dressing of the deficient elements will produce

immediate and abundant effect. A few measures of quicklime may bring into activity a great fund of latent fertility; a few ounces of bone-dust may be the one thing wanted in the soil to put a good crop on a barren tree.

GOIYAS AND AGRICULTURAL SCIENCE.—Were the principal of agricultural chemistry explained to a Sinhalese goya, he would pronounce it a myth and his informant a humbug; but ascribe any special success to having entered into communication with a beneficent demon who for certain considerations came every night to bless the trees, he would firmly believe the statement, and from thenceforth would display an increased respect for the recipient of supernatural favour. As such men have really been the practical creators of the coconut industry in Ceylon, and really knew more of the matter than those who purchased the land, there is nothing surprising in the fact that scientific treatment has not progressed with the breadth of cultivation, and not much can be expected in this direction till the agricultural school begins to turn its graduates loose on society. There are not half-a-score of Europeans that know anything of, and hardly one-half of that number who retain a practical hold on, coconuts. There are no doubt many educated and intelligent proprietors, but very few of these are practical planters, and not one that I have come across will deign to look on the scientific aspect of the culture. I have often heard it laid down as an incontrovertible rule that no coconut should be manured before it came into bearing. I invariably found that the parties asserting it had never tried it. A few weeks ago a party who was not a planter warned me against the practice. I told him that he ought to have dismissed that prejudice with his kondc and his comboy, for it was utterly at variance with a short crop and a pair of tweed trousers. W. B. L.

SOME FACTS AND OPINIONS ABOUT COCONUT CULTIVATION.

(Written in December 1897, by Mr. W. B. Lamont, an experienced Ceylon Coconut Planter.)

CLIMATE, TEMPERATURE AND RAINFALL.—The coconut is essentially a tropical plant. It cannot be profitably cultivated in an average temperature much under 80°. On deep, rich soil it will thrive on an annual rainfall, perhaps, as low as 40 inches; but in the Southern and Western Provinces of Ceylon, which contain at

least three-fifths of all the coconuts in the Island, the soil is, as a rule, poor: the coconut needs 70 inches and upwards, but in districts, with 100 inches or upwards, it is apt to run more to leaf than fruit.

ALLUVIUM.—Alluvial flats by the side of the larger rivers, subject to occasional flooding, are beyond all comparison the most fertile in the Island. It is hard to get coconuts up in such spots, from the rapid and luxurious growth of indigenous plants; but once thoroughly established and in bearing, I am afraid to mention the amount of their annual crops, lest I should be accused of exaggeration, by those who have had no experience of such yields. Such spots are of rare occurrence, and seldom of large extent; but ten acres of such land fully planted and in bearing is worth fifty of the next best.

SAND.—Loving sand, with a good percentage of organic matter, is the second quality, but it is almost as rare in the Southern and Western Provinces, as the first; but by skilful cultivation, it may be brought up to a yield little inferior to the alluvium: the difference being that the great natural fertility of the latter requires only the minimum of trouble and expense, whereas the former requires much of both. The fertility of the one is inexhaustible, that of the latter fails from lapse of time and neglect of cultivation.

BROWN LOAM—The soil, third in order of suitability for coconut cultivation, is the brown crumbly loam, rare in the South-West, but common in the North-West as far inland as the temperature and rainfall is suitable. It is very fertile, but not inexhaustible; and it responds less freely to cultivation and manure than the sandy loam.

GRAVELLY LOAM.—The soil fourth in order is gravelly loam, somewhat stiff and hard, but fairly fertile.

CLAYEY LOAM.—The fifth is clayey loam which, though richer than some of the other mentioned, is, in districts subject to long spells of dry weather, very trying to the plants which sometimes suffer fearfully. This kind of soil yields up its moisture very rapidly, and after a three months' drought, gets as hard and dry as brick, to the depth of two feet. In rainy weather the plants grow vigorously, but they often lose, as much in the dry, as they gain in the wet-season. Such trees, however, as get their roots down into the soil, beyond the reach of drought, generally bear heavy crops; but it is risky to plant such land.

It is deplorable to see trees of ten to fifteen years' standing, dropping bunch after bunch of a heavy crop, and having the greater part of the leaves hanging withered about the stem.

LOAMY GRAVEL.—The sixth quality of soil is the loamy gravel, or rather the gravelly loam—that is to say, when the loam is in excess of the gravel, though seldom very rich, it is fairly fertile and very readily responds to breaking up and manuring.

QUALITY OF SOIL DEPENDENT ON ROCK.—The mechanical constituents of all soils are loam, sand and gravel, with various proportions of organic matter; but each class grades down: light friable loam to stiff impermeable clay; sands grade to such as we see on the seashore, and gravels into pure stones and sand. The quality of soils are governed by the composition of the rock from which they are derived—in some kinds clay predominatos; in others sand, and in some gravel. Then some may be rich in potash, others in lime, in magnesia, in phosphate, and some in all these and other elements that more or less affect fertility. It is, therefore, important to know something about geology in choosing land for coconut cultivation.

VARIETIES.—The coconut sports into so many varieties that in any hundred trees in a field hardly any two of them will be found producing precisely similar fruit in size, form and colour: in size they vary from one to two feet in girth, in form from nearly globular to various degrees of oblong, and in colour from bright green to yellowish brown and in the case of the king coconut to bright yellow. They differ in the prominence of the ridges of the husk, and in the thickness of both husk and kernel. They differ in the length of the leaf-stalk between the stem and the beginning of the leaflets, and they differ in the length of the flower-stalks.

SELECTION OF SEED NUTS.—Amid all this sporting, it is beyond hope to get a single variety for a whole field, but a good progeny may be fairly expected, and a good percentage, therefore, of seed nuts should be taken from select trees. Such a tree should he free of growth and strong in all their members, an early and heavy bearer, carrying its fruit on short stalks. The fruit should be of medium size, oblong in form, thin in husk and thick in kernel, gatherod when fully ripe, but not dry.

MEDIUM SIZE RECOMMENDED.—The largest nuts are usually produced on strong healthy trees, but the numbers are small, the husks thick and the kernels comparatively thin: whereas the medium size gain more in number than they lose in size: the husks are thinner and, as a rule, the smaller the nut the thicker the kernel. I remember two trees, next each other in a line: one bore very large nuts, but its annual crop never reached 30, while its neighbour with very small nuts bore annual crops up to 300 and the weight of copra was four times that of the former. Medium-sized nuts are in all cases to be preferred—not that the fruit of any given tree will produce a copy of its parent, but the chances are that the variety, though better or worse, will not very materially differ.

There may be some more trouble, expense and inconvenience, in selecting trees for seed nut than in picking single nuts from a heap; but the advantages far more than compensate these objections: a bunch of ripe nuts is due every month, but it is the custom to pluck only once in two months, as it saves labour. Nuts cannot be too ripe for copra-making; they may be too ripe for seed; while the second month's bunch may not be ripe enough. In selecting nuts from a heap so gathered, there can be no uniformity in their degree of ripeness. Thus, in a nursery so formed, there will be months of difference in the time they take to germinate: a large percentage will be weak and late, and slow growing plants; and another considerable percentage will not germinate at all. If the bunches from the selected trees be plucked at the proper stage of ripeness, each month they will be more uniform as to time of germinating and in their subsequent rate of growth, both in the nursery and the field; while of feeble, worthless plants and non-germinating nuts there will be few if any.

NURSERY.—The nursery ground should be as nearly level as other circumstances will admit of; it should be near water, as that may be needed in dry weather; it should be trenched 18 inches deep. The nuts should be placed with the stalk end up, which enables the shoot to come up vertically from one or other of the three eyes of the shell; whereas, if laid on its side, it has to turn at right angles, to attain that position on emerging from the husk. The nuts should be buried in the loose earth to within two to three inches of the top; if the purpose is to put out the plants in the field, when they have

four leaves, they need not be placed more than two or three inches apart, but if they are meant to be larger, when removed, they should be given proportionately more room.

CLEARING.—I can suggest no improvement on the plan of preparing jungle land for cultivation, namely cutting down and burning off. I believe the attempt has been made to line and hole, through standing forest; but I cannot see, sufficient advantage in doing so, to compensate the additional toil and expenses.

CLEARING BY GOIYAS.—I believe that ever since coconuts began to be regularly planted in the Western and Southern Provinces, the custom has prevailed of letting the land out to goiyas, to be cropped with fine grains (chiefly kurakkan), roots and vegetables, the land share being one-third of the produce by way of rent. The goiyas cleared and cultivated the land till it ceased to pay them. The owner provided plants and paid the goiyas one fanam for holing and planting. In most cases the land ownor looked for his profit in the land share of the goiyas' crops, rather than in the far away crops of coconuts; therefore where the surface fertility was exhausted, the coconuts were left to nature, and nature set vigorously to work to blot them out of existence. This is the history of many thousands of acres; and then I have known land that at a very moderate cost would have yielded 3,000 nuts by the tenth year, cleared, cropped and replanted three times in twenty years. Large tracts of land have thus been permanently impoverished, because the native land owner prefers paying for work done out of the fund of fertility in the soil than in hard cash: he can handle and count and fondle the latter, while the former is an unknown quantity that will bear being drawn on to any extent.

GOIYAS' WORK.—The wiser plan is to pay cash for work done at current rates and reserve all the fertility of the soil for the permanent cultivation. The goiya knows well how to take the fertility out of the soil—the first year he plants cassava and sweet potatoes, and over these sows kurakkan: this latter allows nothing else to grow while it occupies the ground, but as soon as it is reaped, the cassava takes a start, and is the crop of the second year; the sweet potato has then its nursings and is the crop of the third year. By this time the freshness is pretty well taken out of the soil, but if it be unusually rich, a second crop of kurakkan is taken.

LINING.—The first thing to be done, after clearing the land, is lining. In fine soil 30 ft. by 30 ft. is not too wide; but in no case

should the plants be closer than 25 ft. by 25 ft. The easiest way of doing the work is to get a base by the road tracer and the parallel lines by the compass. It is the usual thing to plant in squares, but there is some advantage gained by planting in triangles. Planted at say 25 feet in squares, each plant will be equi-distant from four others; but with the lines 25 feet apart, the diagonal line will be over 30 feet. In triangles, the distance of all plants to the nearest in adjacent line will be 30 feet and a fraction. In the square of 25 feet, the leaves of adjacent trees will cross from four to six feet: but in the diagonals, there will be space that the leaves of opposite plants do not reach, whereas in triangles that space is reduced from 35 to 30 feet.

HOLING.—Coconut holes *cannot be too deep or too wide*, but as they must be kept within practical lines, let us say three feet cubes. These should be filled in to half their depth with surface soil; and the plant placed in the centre with the crown of the nut at least 15 inches below the general surface, buried to the same depth as in the nursery.

TREATMENT OF PLANTS UP TO FOURTH-YEAR.—As young plants at from 25 to 30 feet apart cannot for years avail themselves of all the space allotted to them, and as to keep all that space clear, through all these years, would be not only expensive, but very injurious to the soil, the best thing to do is to let the jungle grow. By this means, the soil will be protected, from the alternations of heavy rains and burning sunshine. The only work required for four or five years is to keep a clear circle round each plant, and widening them as the roots and leaves extend, by eradicating the jungle and breaking up the surface soil; at the same time the holes should be filled in gradually, an inch every three months or so during the first year and a little more during the second. When the plant carries ten green leaves, it should be brought to the level of the surface. By this process, the freshness of the soil will be reserved, for the use of the cultivated plant, and the last of the jungle will disappear, as the leaves meet across the lines. Treated thus, the earliest tree will flower in the fifth year, and the whole field should be in bearing from the eighth to the tenth year. By the fifth or sixth year, the jungle will be all disposed of, and it only remains to keep the surface soil well broken up and exposed to the action of the air.

PLOUGHING.—This has been tried by the plough: but, in my experience, I have not seen it succeed. The native plough drawn by a pair of buffaloes needs one man to drive and another to hold: it scratches the surface to the depth of three inches or thereabouts, the furrows crossing each other at all sorts of angles, and sometimes two feet apart. Such an operation does little or no good, and is a little less costly than a proper turning over with the mamoty. Ploughing should be deferred till a suitable instrument can be obtained, and a trained ploughman who not only knows how to hold the plough, but can train his cattle to walk straight. A mamoty digging once in two years will suffice in the way of cultivation.

TIMES OF APPLYING MANURE.—Except to stimulate a lagging plant, manure should not be applied to young trees. A field should be allowed to demonstrate what the soil can do for it before attempting to force it. The trees may be very strong, but late of coming into flower; and when they do bear the amount of crop may be disappointing, or they may take on more crop than they have strength for, and drop a large percentage of it at different stages of growth. The first case calls for phosphates, the second for nitrates, and if neither the trees nor their crops are satisfactory.

KINDS OF MANURE NEEDED.—The two kinds may be exhibited at once. If after keeping the surface well broken up and a supply of nitrates and phosphates has been applied, the trees do not behave satisfactorily, a deficiency of some of the mineral elements is indicated and should be supplied in some form; especially something rich in potash, but the coconut seldom suffers from the lack of the mineral elements.

NEED OF MANURING.—Not even the richest soils hold an unlimited supply of the elements of fertility, if brought under cultivation; and if some part of their products be constantly removed in the course of years or ages, the supply must fail and barrenness ensue. When, therefore, in the course of continuous cultivation, the crops regularly diminish in bulk, it is a warning to the cultivator to set about supplying the required elements. If he knows and believes in this theory, he will not wait till his cultivated plant seriously suffers from famine, but will begin to feed it when the first symptom of hunger appears, nay he will be the wiser man, if in the case of the coconut, he will supplement the natural supply of food, before any

sign of failing crops appear, because to augment its resources with immediately available food, will in due proportion increase the crops.

EFFECTS OF MANURES.—Indeed the careful application of manure, in such quality and quantity, at stated times, will double, treble and quadruple the crops of land left to the care of nature.

CATTLE MANURE.—As stated already nitrates and phosphates are the chief manurial elements required by the coconut, and the dung of domestic animals, either pure or mixed with practically decomposed organic matter, contains these and all the other necessary elements, in due proportion. But where is the owner of an extensive coconut property to find enough of this valuable stuff to keep up, not to say improve, the crops? I once knew a property that had no pasture outside of the coconut field, but cattle enough were kept without overstocking to eat all the grass that grew on the land; they had moreover the liberty of the poonac tub. From a considerable extent of low swampy land that produced ferns and coarse grasses, a large quantity of which was put into the cattle sheds daily, it took twelve years to give every tree on the estate 5 cwt. of cattle shed manure. It was a light sandy soil, the kind that most readily responds to manure, and the effect was immediate and marvellous: it only acted for three years, and to keep up the improvement, required a like dose every three years.

CATTLE KEEPING.—There is nothing more certain than that (except for draught or dairy purposes) the breeding and feeding of cattle is not a profitable enterprise and under any condition it is doubtful if the keeping of stock, for the sole object of making manure, will pay: certainly not, if fed on cultivated grass or purchased food. In the case of a coconut field, with no pasture outside its bounds, the keeping of cattle, beyond what is necessary for working and dairy purposes, can only be done at a loss. Cattle do not create the elements of fertility: they only concentrate; and when removed by sale or otherwise, they carry off such part of the fertility of the soil they fed on as has gone to the building up of their bodies. It is better, therefore, to turn the herbage into the soil on the spot where it grows, than to expend a larger sum than this would cost in housing, herding, transport of manure, &c., for no better purpose than robbing one part of the land to feed another. Of course, an estate that has the run of pasturage outside the coconut field may possibly keep cattle profitably. It is hardly possible, however, to obtain from any source a sufficient

supply of dung to materially increase the general yield of a coconut field.

KINDS OF MANURE.—The planter who wishes to double or treble the yield must go to market to obtain a more concentrated manure in sufficient measure. Coconut poonac applied directly to the soil should be a very efficient manure, as it contains all the elements required by the cultivated plant; but at the rate it now sells, it is probable that an equally rich material may be got at a less price: castor cake, for instance, is said to be richer in nitrates than poonac, and, as it cannot be used as a feeding stuff, is probably the cheaper article. The planter who applies castor cake and bone dust, both or either, as the case requires, will be sure to profit by the transaction; the tree is besides grateful for any readily decomposed vegetable substance that is turned into the soil, and any one that chooses can have a special manure compounded to order by any European manufacturer.

METHODS OF APPLYING MANURE.—It is still a common practice—a most slovenly and wasteful one—to tie cattle to coconut trees by way of manuring them. Immediately round the stem, the primary roots are massed closely together, and it is only at three or four feet distant that they emerge from the cluster, and each radiates outwards, on its own straight line. Though these roots go down to a great depth the tree is essentially a surface feeder, and they are most numerous within a foot of the surface.

TYING CATTLE.—Tying two head of cattle to the tree for ten nights, what with treading and what with the fresh urine, kill off all roots within six inches of the surface, thus depriving the tree of its wider range of feeding ground, and the immediate effect is a falling-off rather than improvement. If the dung be dug into the soil at once, the tree revives and flourishes till the supply is exhausted, when it rapidly falls off to a worse state than before the application; but the more common practice is to let it alone. As the feeding roots of plants do their work underground, dung left on the surface is so much good stuff wasted, besides (in the case of the coconut) injuring the tree by inducing it to throw out primary roots above ground, in an abortive endeavour to reach the food from above, which it cannot avail itself of from below.

CIRCULAR TRENCHES.—Hardly more scientific is putting manure into circular trenches. It is true that the tree can by this method at once avail itself of the supply, but as all primary roots are served to

the depth of the trench, it is cut off from its usual feeding ground, and must depend entirely on the artificial application, those cut roots having been its sole resource for drawing nourishment from the outside soil, within the depth of trench, say one foot, which is deeper than the chief feeding space of the plant. It is astonishing how far the primary roots travel in light loose soil. I once measured one washed out on the seashore fifty-three feet long. The poorer the soil these roots extend the faster and the farther.

TILLAGE OF SOILS.—With the exception of soils in which sand is the prevailing ingredient, Ceylon lowcountry soils are hard and stiff, or become so rapidly on exposure. Light loams and gravels, on being broken up to the usual tillage depth, from six to nine inches, do not resume the hard solidity of their former state; but to keep them in the proper mechanical state for the coconut roots, the operation should be repeated periodically, as nothing conduces more to the rapid growth of the plant than a loose permeable soil. Manure should only be applied at these periodical diggings. Dung should be broken up and spread as evenly as possible over the whole surface, and such as bone dust and oil cake may be sown broadcast; and whatever kind of manure is used, it should be turned into the soil without delay.

SPREADING MANURE AND EFFECTS.—The roots of the coconut are most vigorous and active towards the extremity of the primaries and these qualities gradually diminish towards their origin on the stem, because in their outward course, they have already appropriated the cream of the soil's elemental wealth. Therefore manure in the centre between two lines of trees is more immediately effective, than within six feet of the stem even if cattle tying and circular trenches are avoided.

PROBABLE RESULTS FINANCIALLY.—Periodical digging and manuring is the propper treatment of a coconut field so far as my judgment and experience goes. As already stated, the first digging may be spread over several years, by merely extending the tilled circle round each plant, as it requires more room. On 70 trees to the acre, the cost of this first clearing and digging will not be more than R10 or R2·50 per annum, supposing it extends over four years. No subsequent digging should cost more than R7 per acre. 350 lb. of bone dust and 350 lb. of castor cake applied to an acre of trees already bearing more or less, will within four years add 4,200 nuts to the crop. Supposing the manure to cost 5 cents per pound the cost

will be R35 per acre; add R7 for labour—R42 or exactly R10 per 1,000 on the increased crop. The profit will thus be the difference between the selling price per 1,000 and R10.

WHAT MAY BE EXPECTED OF PROPER TREATMENT.—The hole system consists of the regular tillage of the soil, and the perodical application of a fixed amount of suitable manure. There is no increase of crop in the first year of applying manure; but there is a considerable increase in the second, and a still greater one in the third; but in the fourth there will be a falling-off from the crop of the third year. To renew the operation of digging and manuring every second year, will therefore not only maintain the highest yield reached, but increase it year by year without any practical limit. It is well-known that individual coconut trees of good jât, that have happened to grow on a spot of naturally rich soil, habitually yield from 300 to 400 nuts per annum without any cultivation. It is then an extravagant idea that a field yielding from two to three thousand nuts per acre, with little or no cultivation, may with scientific treatment be made to yield double those numbers in a few years.

WHITE ANTS.—The coconut husk is not to the taste of the white ant till it has undergone some change in the direction of decay, and then only, when more desirable substances are scarce. In transplanting from the nursery to the field, all roots that have got beyond the nut, are shaved off, being of no use to the plant in its new position. It is about this time that the husk reaches the condition that suits the white ants, and if they discover it before the plant has had time to send fresh roots into the soil, they eat out the whole interior often in a single night, the consequence of which is the death of the plant, it being deprived of any medium into which to throw out roots. This is not common in newly opened forest or old chena, as this insect does not thrive under heavy shade but is frequent in planting in open land. I first became acquainted with it, in planting coconuts in the vacancies of an old cinnamon field, where I lost above 100 plants within a week. The preventive measure which I took was fairly successful: I thickened a strong solution of salt with fresh cowdung and covered the nuts with the compound.

CATTLE.—Cattle and goats are very destructive on a young coconut field, and at any cost should be kept out. It is simply impossible to get up the plants on a spot open to cattle, and strong fencing and sharp watchfulness are both necessary for their protection.

They are not out of danger till they carry ten or twelve leaves, with the central ones too tall for the animals to reach.

THE COCONUT WEEVIL—KANDAPANUWA.—As soon as the tree shows stem above ground it becomes liable to the attack of the cocoanut beetle or weevil, an insect about an inch long with a horn in front: its colour is red with a few small black specks, and it is nocturnal in habit. It cannot penetrate the hard outer crust of a mature cocoanut stem, but it lies in wait for any crack or wound that it can prepare by its frontal horn, for the reception of its eggs. The substance of a young cocoanut stem within its outer crust is somewhat harder than that of a raw potato, and this is the food of the young grub which as soon as hatched begins to eat its course inwards and upwards, enlarging the opening as it grows, till when about two inches long it works its way toward the outside, where just under the outer crust, to which it comes so near and which is hardly thicker than a stout sheet of paper, it wraps itself in a cocoon of the more mature fibres near the surface, to abide its transformation; and when it occurs the mature insect easily sets itself free, by breaking through the thin crust that has been prepared for that purpose. Up to this time, there may be an hundred grubs at work inside the stem, without any visible external sign of their presence. Sometimes the fall of the whole head of leaves is the first intimation that anything is the matter with it. If the first entrance has been made on any open part of the stem, the presence of the grub may be detected by the flow of a dark liquid from the opening.

By whatever means the presence of the grub may be detected, there is only one effectual means of dealing with it. Dig out the tree, chop it into fragments, and subject them to the action of fire.

When the stem forms above ground the leaves stick to it with great tenacity and persistency, and form a close imbricated cover to the still tender rind. Let no leaf therefore be cut or torn from the stem at any stage, but leave them to rot off, *in situ*, after performing their function. The weevil cannot make way through the closely-packed leaves that surround the stem, but sometimes in the case of a quick-growing tree, nourished by a rich surface soil, the stem expands into a bulb and bursts the outer leaves, while still green and strong. Of such an opening the insect is sure to avail itself. Such split leaves (always the outer ones) may be shaved off with a sharp knife, taking care not injure the stem in the process. Never search

for the grubs in suspected trees, and never cut holes in the stem in the hope of saving the tree. It is better to lose a tree here and there than run the risk of losing a great many by injudicious meddling. It is some comfort to know that the whole colony remains attached to their native tree till it is thoroughly consumed, so that when dug out and burned, we destroy the whole family in all stages of existence. Till this evil has fully declared itself, judicious letting alone is best.

THE COCKCHAFER—KURUMINIYA.—Most people know the great big buzzing blundering cockchafer that getting into a lighted room dashes his head so violently against the wall. Its breeding places are dunghills and rubbish heaps, where in the pupa state it battens on its surroundings. In its perfect state it is not less voracious, but more dainty; its favourite food is the tender undeveloped leaves in the head of the coconut tree, and to it is due the ragged and clipped appearance of the leaves of trees that suit its taste. It is more than doubtful whether keeping a staff of beaters, as I have known being done, to hunt these insects in the trees, is useful. The same labour would probably be more profitably employed, in hunting the grubs in their breeding places. There is no doubt that its operations are injurious to the tree, but, happily, except in the case of a very young one, it does not kill any outright.

RATS.—Rats are very troublesome and destructive when they succeed in establishing themselves on an estate. They breed on the trees and find both food and drink in the young nuts, especially those with soft husks. They operate by cutting a hole and and eating out the inside of the nut, which, of course, falls soon after. Some native planters put a band of tar round the stems which effectually prevents their climbing; but where the leaves of the adjacent trees cross, they have no difficulty in passing from one to another. Others have a firm faith in the keeping of donkeys, whose braying they affirm frightens the rodents so much that they evacuate the vicinity of such awful noise. This result is more than doubtful, but the experiment is not costly. I know no effectual remedy for this pest: traps and poison are useless under the circumstances.

LOCUSTS.—We are not much troubled in Ceylon with locusts, but ometimes a small troop of them attack a few trees in a field. About thirty years ago a formidable host of them appeared in and about Colombo, and especially in Captain's Garden, where they denuded the trees of all their leaflets, leaving only the bare midribs or "eckles."

LAY OF LAND.—The ideal lay of a coconut field is a slightly undulating plain, nowhere so steep that a loaded cart cannot be taken over every part of it, so as to facilitate the collection of crop. Steeper land is not to be rejected if the soil is suitable, but it does not lend itself freely to cultivation, and the collection of crop is more costly. It is not a bad plan to terrace such land, and make each tree the centre of its own platform; but it is best not to plant it if a more suitable lay be available.

CROP GATHERING.—In dealing with crop, it is the custom to gather only once in two months though one bunch is due every month. As two bunches are taken on these occasions, one bunch must be riper than the other. So long as the trees are not too high to be reached by a hook on a long pole, gathering may be done monthly without any increase of cost for plucking; but when it becomes necessary to climb the trees, care should be taken that the second bunch is thoroughly ripe; the first cannot be ripe too, so it is a mere matter of time. The best way of getting the climbing done is by contract, for which Cochin men are often available. The heaviest job of work connected with securing the crop, is a work requiring both strength and skill.

HUSKING AND DRYING.—I once suggested to David Wilson a machine not for husking but for splitting the whole nut into two halves. He caught and approved of the idea, but he had at that time several other ideas to patent, that it slipped out of his mind; and I had too little confidence in it myself to carry it further.

ARTIFICIAL DRYING.—The more perfectly ripe the nuts are they contain the less moisture in the kernel and consequently require the less drying, and the sooner they are husked and dried after gathering the better, for the quality of the copra. To this end, every property in districts where three or four consecutive dry days cannot be depended on, should have some artificial means of quick drying, more perfect and cleanly than the rude smoke kiln in common use. Almost any mechanical engineer could furnish the plan of a chamber in which the temperature could be kept up to 200° which would complete the drying in twenty-four hours in any weather.

THE VIEW OF THE AVERAGE ESTATE OWNER.—"What good," says the routine planter, "I sell my nuts at current rates, and their after-treatment is no business of mine. All this additional expense and

trouble will not pay me, while they mix all qualities of copra at the mills, and produce an inferior quality of oil, giving hardly more for my superior article than for the unripe, half dried and discoloured stuff with which they mix it, especially if I have to send it to market by cart."

REMEDIES.—There is much truth in this view of the case, but the planter may make and export the oil on his own account or he may export his copra to a better market or in some other way protect his own interests. I believe there is no other reason than a bad system of long standing, why Cochin oil should sell thirty-six per cent higher than Ceylon produce; and I believe the remedy lies with the planters themselves. It is well within their power to intercept and appropriate, at least one half, of the difference between the market value of Cochin and Ceylon oil.

GENERAL ESTIMATES.—I leave every one who may adopt any of my recommendations to make his own estimate of cost according to local circumstances; they will cost more in one district than another, and in the hands of one man more than another.

W. B. LAMONT.

KOSGALLA, RATNAPURA; Dec., 1897.

COCONUT PALMS.

Estimated Cost of Planting and Cultivating 100 acres of Coconuts for 10 Years, in the Western Province of Ceylon.

Year.		R.	R.
I.—	100 acres laid at R10 and Government charges	1,500	
	Felling, Clearing, and Fencing	1,000	
	Holes 2½ by 2½ by 2½ 7,500 at 4 cents each	300	
	Planting	40	
	Ditches, etc.	200	
	Nursery : 10,000 nuts at R30 per 1,000	300	
	Tools and Sundries	50	
	House for Kangany	50	
	Kangany	150	
			3,590
II.—	Weeding	600	
	Nursery : 1,000 nut for supplies	30	
	Kangany	150	
			780
III.—	Weeding	600	
	Repairs, &c.	10	
	Kangany	150	
			760
IV.—	Weeding	300	
	Repairs, Fence, &c.	50	
	Kangany	150	
			500
V.—	Weeding	300	
	Repairs, Tools, &c.	10	
	Kangany	150	
			460
VI.—	Weeding	250	
	Nursery : 1,000 nuts for supplies	30	
	Kangany	150	
			430
VII.—	Weeding	250	
	Repairs and Tools	20	
	Kangany	150	
			420
VIII.—	Weeding	200	
	Kangany	150	
			350
IX.—	Weeding	200	
	Kangany	150	
			350
X.—	Weeding	200	
	Inspection and Sundries, 10 years	210	
	Kangany	150	
			500
			R8,200
	Interest—Nine years at 7 per cent		4,700
			R12,900

Note 1.—If given out to goiyas (native cultivators) there will be a saving of about R2,900, which will leave the nett cost of estate R10,000.

Note 2.—Crop to the value of R200 or so may be expected between close of 8th and 10th years.

Note 3.—At close of 15th year should yield from R2,000 to R2,500; at close of 20th year should yield from R3,500 to R4,000.

Note 4.—Value at close of 10th year R20,000.
Do. do. 15th do R30,000.
Do. do. 20th do R50,000.

Note 5.—Above calculations made on the supposition that the soil and climate are first-class.

PRACTICAL RESULTS OF COCONUT CULTIVATION IN CEYLON.

We were favoured some time ago with the following figures by an Estate Manager as per his books :—

FROM APRIL 1886 TO SEPTEMBER 1894.

I enclose the cost of my estate up to September, 1894. You will observe that the cost of buildings is high. The bungalow is a large and commodious and permanent one, built of brick and lime; and so is store and lines. The estate has no vacancies. I am gathering from 2,000 to 4,000 per month. I have already gathered 29,000 nuts from the trees that are coming in to bearing. I get the highest price for my nuts and copperah. My salary as Superintendent is not charged in the books. The Superintendent is the man I employed before I took charge of the estate and came to reside there. The cinnamon has been rooted out and all is now planted with coconuts. My weeding to date is about 44 cents per acre per month since I commenced it. I have 275 acres, all planted, and only a small portion of it has come into bearing :

1	Clearing	R2,380·84	10	Manuring	R 243·87
2	Holing	2,091·76	11	Cattle and Sheep	1,811·62
3	Weeding	10,678·77	12	Vanilla and Pepper	107·08
4	Planting	563·94	13	Plucking and removing Coconuts	189·22
5	Roads and Bridges	821·67	14	Terracing	39·06
6	General Transport	17·71	15	Cinnamon	216·04
7	Tools and Machinery	547·75	16	Superintendent	1,499·06
8	Miscellaneous	4,435·80			
9	Lines, Store and Bungalow	8,376·75		Total	R34,023 94

COCONUT PLANTING IN CEYLON IN 1897:

DETAILED ESTIMATE FOR 200-ACRE ESTATE FOR 10 YEARS WITH EXPLANATORY NOTES.

(By a Practical Planter.)

We have pleasure in presenting our readers with the following carefully prepared estimate—see over—from the hands of one of the most reliable coconut planters in Ceylon. It supplies full details of expenditure, year by year, for ten years from the first clearing of the land; allows interest on such annual expenditure at 8 per cent; and shews that the aggregate outlay is R74,053 plus interest R44,478 or a total of R118,531 which gives nearly R600 per acre or deducting the receipts in nuts for three years nearly R470 per acre. We think this is a very *safe* estimate. The crops are moderately estimated and moderately priced at R27 per 1,000; while we cannot help thinking that the allowance for expenditure is ample, though good land might cost more. At the same time, as the "notes" show, it is recommended that there should be 100 acres of pasture land as reserves and this would mean a cost of R1,000 more at least. As to eventual receipts, it will be observed that the anticipation is of three-quarter and even one million of nuts per annum—a maximum average of 5,000 per acre, or 67 per tree. This would require liberal cultivation to keep up. A million nuts would give R27,000 per annum of gross receipts—less, say, R10,000 outlay—or a profit of R17,000 or R58 per acre per annum. The detailed figures are on the following pages:—

ESTIMATE OF COST OF PLANTING AND CULTIVATING 200 ACRES OF COCONUT UP TO THE 10th YEAR, SHOWING ALSO PROBABLE RECEIPTS FOR SAME PERIOD.

ANALYSIS OF ESTIMATED EXPENDITURE.

Description of Works.	Cost.	8 % Interest	Total.
1st Year.	Rs.	Rs.	Rs.
Value of Land, 200 acres at R20	4,000		
19,500 selected Seed Nuts at R75 per 1,000 ...	1,463		
Preparing and Tending Nurseries	120		
Felling, Clearing and Fencing	3,000		
Drains, Roads and Bridges	200		
Lining 24 × 24, and Holing 3' × 3' × 3'	1,250		
Filling in 18" and Planting	350		
Weeding, 8 months	1,600		
Watching	160		
Buildings	1,000		
Tools and Implements	200		
Superintendence	2,000		
Contingencies	200		
Total ...	15,543	1,243	16,786
2nd Year.			
Fence	120		
Drains, Roads and Bridges	200		
Supplies and Supplying	80		
Beetles and other Enemies	100		
Weeding	2,400		
Watching	240		
Buildings	100		
Superintendence	2,000		
Contingencies	200		
Total ...	5,440	1,779	7,219
3rd Year.			
Same as above with additional R50 for Tools			
Total ...	5,490	2,359	7,849
4th Year.			
Fence	80		
Drains, Roads and Bridges	200		
Beetles and other Enemies	100		
Digging and Forking round plants	200		
Weeding	1,800		
Watching	240		
Buildings	100		
Superintendence	2,000		
Contingencies	200		
Total ...	4,920	2,942	7,862
Carried over	31,393	8,323	39,716

ESTIMATE OF COST OF PLANTING, &c.—*Continued.*

ANALYSIS OF ESTIMATED EXPENDITURE.

DESCRIPTION OF WORKS.	COST.	8% Interest	TOTAL.
	Rs.	Rs.	Rs.
Brought forward	31,393	8,323	39,716
5th Year.			
Fence	75		
Drains, Roads and Bridges	200		
Beetles and other Enemies	150		
Digging and Forking round plants	225		
Weeding	1,800		
Watching	240		
Buildings	100		
Tools and Implements	100		
Superintendence	2,500		
Contingencies	200		
Total ...	5,590	3,625	9,215
6th Year.			
Fence	75		
Drains, Roads and Bridges	100		
Beetles	150		
Digging and Forking round plants	250		
Weeding	1,500		
Watching	210		
Buildings	3,100		
Superintendence	2,500		
Contingencies	200		
Total ...	8,115	4,563	12,678
7th Year.			
Fence	75		
Drains, Roads and Bridges	100		
Beetles and other Enemies	100		
Ploughing half the estate, 100 acres	150		
Purchase and Keep of Stock	1,150		
Weeding and Clearing Tope	1,200		
Watching	240		
Buildings	100		
Tools and Implements	125		
Superintendence	2,500		
Contingencies	200		
Total ...	5,940	5,404	11,344
8th Year.			
Fence	75		
Drains, Roads and Bridges	100		
Beetles and other Enemies	50		
Ploughing other half of estate, 100 acres ...	150		
Keep of Stock	550		
Weeding and Clearing Tope	1,200		
Watching	360		
Carried over	51,038	21,915	72,953

ESTIMATE OF COST OF PLANTING, &c.—*Continued*

ANALYSIS OF ESTIMATED EXPENDITURE.

Description of Works.	Cost.	8% Interest	Total.
	Rs.	Rs.	Rs.
Brought forward	51,038	21,915	72,953
8th Year.—(Contd.)			
Buildings	200		
Picking and Gathering Crop	200		
Tools and Implements	200		
Superintendence	2,500		
Contingencies	200		
Total ...	5,785	6,299	12,084
9th Year.			
Fence	75		
Drains, Roads and Bridges	100		
Beetles and other Enemies	50		
Ploughing 100 acres @ R1	100		
Keep of Stock	550		
Picking and Gathering Crop	250		
Weeding and Clearing Tope	1,200		
Watching	360		
Buildings	200		
Tools and Implements	75		
Cost and Transport of Manure	2,500		
Application of Manure	300		
Superintendence	2,500		
Contingencies	250		
Total ...	8,510	7,484	15,994
10th Year.			
Fence	85		
Drains, Roads and Bridges	100		
Beetles and other Enemies	50		
Ploughing 100 acres @ R1	100		
Keep of Stock	550		
Picking and Gathering Crop	450		
Weeding and Clearing Tope	1,200		
Watching	360		
Buildings	200		
Tools and Implements	75		
Cost and Transport of Manure	2,500		
Application of Manure	300		
Superintendence	2,500		
Contingencies	250		
Total ...	8,720	8,780	17,500
	74,053	44,478	118,531
Less Receipts :—			
8th Year 130,000 nuts @ R27 ... R3,510			
9th „ 250,000 „ „ R27 ... R6,750			
10th „ 420,000 „ „ R27 ... R11,340			
	21,600	2,942	24,542
Net Cost of Estate			93,989

NOTES ON ESTIMATE.

It is assumed that the soil is good, the climate favourable, and the land so situated as to admit of its being opened and worked at a moderate cost.

1ST YEAR.

EXTENT AND VALUE OF LAND.—To cultivate highly an estate of 200 acres, after it has come into bearing, it would be as well to have an additional 100 acres of pasture land, so that a sufficient number of cattle might be kept for manuring purposes, as the estate itself would not maintain the stock required to manure half the total extent every year.

R20 per acre, is of course, but a nominal price as superior forest land in favourite districts often sells for as much as R100 per acre.

SEED NUTS, NURSERIES, AND SUPPLIES.—The selection of seed nuts is a matter of primary importance, but it does not generally receive the attention which it deserves. Attempts at economy in regard to the purchase of these are a great mistake and only result in loss. Nuts for nurseries should be thoroughly ripe and be known to come from healthy, middle aged, heavy bearing trees An allowance of 30% more seed nuts than the number of plants to the acre is necessary, namely, 10% for failures in the nurseries and 20% for supplies in the first 3 years. After planting rhe clearing, the surplus seedlings should be removed from the nurseries and put down 3 feet apart in a suitable site and receive careful attention. When supplying, remove every alternate plant on each occasion, so that those which remain may have more space as they grow up. By adopting this plan with supplies uniformity is likely to be secured as there would be no disparity in the original plantation and supplies in respect of age and size.

FENCE.—The timber on the land should provide materials for a fence which should not cost much to run up, and, with occasional repairs, ought to last about 2 years, but a good strong live fence is a desideratum and should be got up as early as possible. *Erandu*, (Sinh.) interspersed with *Erabadu*, (Sinh.) and *Imbul* (Sinh. for cotton) all grown either from cuttings or seed, the former preferable would make a neat and efficient fence, and the last-named would also give

a small profit by its yield of kapok. There are a variety of plants which might be used for fences, but those named are easily procured and will usually be found the most suitable.

ROADS.—Provision is made for gradually gravelling the principal roads.

DISTANCE BETWEEN THE TREES.—24′ × 24′ is the proper distance in soil of average quality, but it should be modified to suit the various classes of soils, the extremes being 22′ × 22′ in inferior soil and 26′ × 26′ in superior soil. Some planters prefer 28′ × 28′ in the latter description of soil, but this is certainly a waste of valuable land, for the superfluous space afforded the trees cannot result in increase of individual yield, and, therefore, the crop per acre, with the fewer number of trees, must be considerably less.

WEEDING—should begin early and be done chiefly by hand. All weeds should be either pulled up or cut out and left to wither on the ground before they begin to form their seed, while any jungle roots that have retained their vitality after the burning should be vigorously attacked with the "coontanie." It would be as well to encourage the growth of the gramineous and leguminous herbage as it is not necessary or advisable that the surface should be kept quite bare, except a space immediately round the plants which should be gradually extended till a circle about 6 feet in diameter is reached in the third year.

BUILDINGS.—A sum of R1,000 is put down for temporary bungalow with wattle and daub walls and a thatched roof: also a set of coolie lines.

4TH YEAR.

DIGGING ROUND PLANTS.—By the 4th year the holes will have filled up to a level with the surface, and the soil within the bare space round the plants might now be loosened to a depth of about 9 inches, and for this purpose a 12-inch three-pronged digging fork will generally be found the most serviceable.

5TH YEAR.

SUPERINTENDENCE.—An increase of R500 is allowed.

WEEDING—should cost a great deal less in the fifth year and still less in subsequent years, but from the 7th year onwards there will be an increasing quantity of "droppings" from

the trees, and provision is made for their disposal preparatory to burning or burying.

6TH YEAR.

BUILDINGS.—The building of a permanent bungalow might now be considered, and accordingly the moderate sum of R3,000 is allowed for the erection; but the cost will, of course, be in proportion to the size and style of the building. R100 are also put down for coolie lines.

7TH YEAR.

PLOUGHING the whole surface might now advantageously supersede digging round the plants, one-half the estate being so treated every year, for it would be quite sufficient if the soil were ploughed in alternate years.

STOCK.—Four pairs of draught bullocks and their keep for the year are estimated to cost R1,150, and three ploughs R125.

9TH YEAR.

COST AND APPLICATION OF MANURE.—If it be desired to get the trees into full bearing earlier than they would if left to nature 2nd to increase their fecundity, recourse should be had to manure. at is assumed that the available pasturage is sufficent to maintain 125 head of cattle, which number is required for manuring one-half of the estate each year. In manuring proceed as follows:—Tether two head of cattle to each tree for five nights. At the end of that period spread out the droppings over a circle 12 feet in diameter—the tree being the centre—sprinkle 3 lb. bone dust over the droppings and dig into a depth of 9 inches, incorporating the manures with the soil. If cattle manure is not available, apply a mixture of 3 lb. bones and 6 lb. castor cake in the manner above indicated, and immediately afterwards scatter 6 lb. wood ashes over the manured surface and gently rake in.

It will be observed that no provision is made for the purchase and keep of stock other than draught bullocks, but if it is intended to keep cattle for manuring purposes, a number of cows and heifers and a stud bull might be purchased in the 5th year, and in time the herd will increase so as to meet all requirements of the estate supplemented by such cattle as the villagers will readily offer for grazing on the estate.

If opened on the "Goiya" system the cost of felling, clearing, and fencing in the first year (R3,000) will be saved, and in favourable

cases the owner's share of the subsidiary crops will realise R20 to R25 per acre for the two years.

RECEIPTS.

8th year.—No crop is estimated for before this year, for although under favourable conditions there would certainly be some crop in the 6th and 7th years, it has been left out of the calculation as its amount is uncertain. 130,000 nuts may be expected in the 8th year worth at R27 per thousand, R3,510.

9th year.—250,000 nuts value R6,750.

10th year.—420,000 nuts value R11,340.

The crop will increase year by year to about 750,000 nuts in the 15th year. With liberal cultivation and manuring it may be further increased to a million nuts, and the yield maintained at the figure up to the 70th year probably. G. T. N.

DESICCATING COCONUT.

This is done with best selected well-matured nuts—the unripe, over-ripe and unsound being carefully rejected and converted into copperah, which being inferior generally fetches a low figure per candy. The desiccating starts by men opening or shelling the nuts, which is done with little hatchets somewhat lighter than an ordinary shingling hatchet; at some mills little circular saws are used, but I prefer the hatchet. The men become very expert at this, but at first their wrists swell up and they cannot earn a good day's wage. They get paid, as a rule, 50 cents, per 1,000 nuts, and many of the best choppers make over R1 per diem. They are then passed on to the paring or shaving women who take off all the red rind, leaving the pure white kernel. They are then passed on to the washing tanks where boys with little pieces of tin, made like nutmeg graters, rub off any red specks the women may have missed. The implement used by the women is a common carpenter's spoke-shave which has to be constantly sharpened, and the nuts must be broken so as to let the milk run out. If left in, it is said, to turn the stuff yellow. For this work the women get 50 cents per 1,000 nuts and the best can shave 1,200 in a day of 12 hours, often finishing their work by 4 p.m.

The nuts, after being thoroughly washed, are then passed on to the Disintegrating Machine and ground to a mass just like your cook does it for curry. In this condition it is taken away in trollies to the Desiccators (Brown's) and dried at a temperature of 160°. It comes out quite hot; and after cooling down to luke-warm it is graded by sifters or by hand sieves into the three-grades—Fine, Medium, Coarse—and while still warm it is packed at once into ordinary tea chests, lead and paper lined, as a rule 130 lbs. net per chest. The chests are then marked, hooped and despatched.

All nuts, if for copperah, desiccating, or shipping, must be heaped and withered (matured) in the husk for three weeks before they are fit for the market. The usual rate for husking is also 50 cents per 1,000, and this, like plucking, is done by men who come round regularly for the job. The buyer pays the cost of husking.

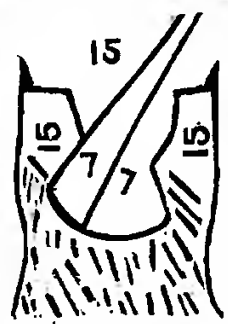
The parings are kiln and sun dried and sell for R33·50 to R45·00 per candy to chekku men, being rich in oil. Other grades are made, such as chips and strips, by special machines for the purpose, only two of which we have here. C. M. B. W.

APPENDIX.

THE "CHEKKU."

OR SINHALESE MILL FOR MANUFACTURING COCONUT OIL.

The native oil-mill or chekku may be of wood, stone, or iron; it is a large mortar, firmly fixed in the ground, and a corresponding pestle, wrought by a lever, with which a pair of bullocks travel round in a circle. The accompanying sketch shows the forms of the mortar and pestle. The chekku stands about three and a half feet high. The lever is made to fit into a cup, on one end of a piece of hard strong wood, about three feet long: the lower end of which has a hole through which a rope is passed, to suspend the lever. The lever is a straight tree, taken up by the root, sixteen feet long, and large enough to square one foot at the lower end, and not less than six inches at the upper. The root is cut to fit a grove round the chekku, and at four feet from the groove a piece of strong wood, six inches by three, is passed through a mortice, and firmly secured, and a hole at the upper end corresponds with that on the lower end of the cup piece, and the lever can be raised or depressed by lengthening or shortening the connecting rope. The action of the pestle, when the machine is at work, is a double one, of grinding and pressing; in front of the pestle, the copra* is thrust down the opening, between the pestle and the mouth of the chamber, and is pressed upwards again, after the pestle has passed over it, and the business of the attendant is to return all that is thrown out on the table, and to break up and turn the cake from time to time.



For the chekku work, the copra must be as dry as the sun can make it, and if put in hot, so much the better. A "turn" of copra is 42 lb., and should the chekku be in perfect order, and the copra perfectly dry, the result will be 28 lb. oil, and 14 lb. poonac; six turns is a day's work: 252 lb. copra equal 168 lb. oil and 84 lb. poonac.

There are only three kinds of wood used for chekkus:—kón‡, tamarind†, satin §, and the same for pestles, to which may be added very old and very hard coconut wood. The pestles are the most costly part of the upkeep of a chekku, as many of them split the first turn. Stone chekkus are from R10 to R70 at the quarries, and an iron pestle, though costly at first, is cheapest in the end. Iron chekkus cost some R250 in England f. o. b., and they are apt to be spoiled, by the conceit of the home engineers, who usually fancy that they can improve on the drawings or models sent them. I have had several improved into impracticability by this means.

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* Copra is the dried kernel of the coconut. † Schleichera trijuga.
‡ Chloroxylon swietenia. § Tamarindus officinalis.

PROFITABLE COCONUT CULTIVATION IN CEYLON.

(From an Old and Practical Coconut Planter.)

HAPITIGAM KORALE, 9TH JUNE, 1886.

I was lucky enough to finish all the planting I can do this season, while the rain lasted, and the goyiyas have very nearly finished their sowings, so that our operations bid fair for success all round. The goyiyas having felled and cleared the land, the owners' work begins, and the following is the cost of my operations :—

Lining per acre ...	...	...	...	R0·25
Holing „ ...	...	...	...	2·25
Plants „ ...	...	...	...	3·00
Planting and Carriage	...	...	...	0·37
				R5·87

Being only five miles from a railway station, I have, on this occasion, cleared R8·50 per acre for firewood for the engines, so that the operations of the season leaves me R2·63 per acre profit.

The goyiyas keep the land in hand for three years; they first sow kurakkan and mun-eta, and then mamotie-weed the land by way of harrowing, then sprigs of sweet-potato vine are put ten or twelve feet apart, and bits of cassava stem five or six feet apart. The grain and pulse first take up the growing, and keep everything else down, while they occupy the ground; when they are harvested, in the fourth month after sowing, the cassava gets its innings, and keeps the ground for about a year. The sweet-potatoes come in at the end and continue to be gathered for twelve months at most. Of all those crops, the land share is one-third, and the value may amount to anything between five and thirty rupees, according to the soil and seasons, but, taking the mid-term of R15, we have nearly R20 per acre, to the good, at the end of the third year. As soon as the crops are finished, any germs of jungle, that survive in the land, rush up at once, lantana shoots up in all directions, and the seeds of kinds of weeds, common in the vicinity, find their way to the land. All these are easily and cheaply dealt with at first, but if allowed to spread, they soon close in and overtop the plants, and those that are not fairly smothered out, have to maintain a severe struggle for existence, being in no case the fittest to survive. At a cost not averaging more than R5 per acre per annum, a fine field of natural pasture grass may be established, and keep up till the trees come into bearing. Of 200 plants I put down in May 1879, ten per cent are now in flower, and I have already gathered nuts from the most forward tree.

COCONUT CULTIVATION IN CEYLON.

We direct attention to the very valuable notes for young coconut planters given below, compiled and placed at our disposal by "W. H. W." —initials which will be readily recognised as those of one of the most successful planters in the island. How he has made his Mirigama property so great a success will be at once understood after perusing his instructions to all who wish to follow his steps and have a thoroughly satisfactory coconut clearing and plantation of their own. How very differently many planters have acted is only too evident in what we see in many directions even in regular plantations; while native gardens are in the majority of cases planted after the most haphazard fashion. One exception to the rule in the case of small gardens was that for which we quote statistics

below, to which our esteemed correspondent "Polgaha" makes reference elsewhere.

MR. DE SOYSA'S MOUNT LAVINIA GARDEN PLANTED ORIGINALLY BY REV. DR. MACVICAR.

One of the best little gardens we know in the island is that from which we are enabled on the best authority to give the return of crops gathered as follows:

G.– B., 14 acres in extent, with 1,151 bearing coconut trees standing thereon, or about 82 trees per acre:

Produce in	1883	57,000	nuts.
,,	1884	56,200	,,
,,	1885	57,600	,,
,,	1886	58,300	,,
,,	1887	59,000	,,
,,	1888	59,600	,,
,,	1889	60,300	,,
,,	1890	60,500	,,
,,	1891	61,000	,,
,,	1892	60,700	,,
	Total...	590,200	,,

Average for ten years 59,020 nuts: per acre 4,215 nuts; per tree per annum about 51½ nuts. We do not think there are many places in the country that can show a better return than the above for ten years continuously.

The garden in question is situated opposite the Mount Lavinia Hotel, and was originally planted with very great care some time in the "forties" under the supervision of the Rev. J. G. Macvicar, the learned and accomplished Scottish chaplain of that day. Mr. Macvicar bought Mount Lavinia from Government (as a great bargain) and going to reside in it, he, in his leisure time, gave attention to planting the 14 acres of waste land opposite with coconuts. Very vividly did the chaplain's daughter, Mrs. Green who has just gone to England lately recall the scene to us when, as a very little girl, she watched her father's careful selection of the nuts (after the fashion prescribed by "W. H. W.") for his servants to put in the nursery. The garden is on fairly good soil, much of it cabook, and it has been favoured with washings from the high road and higher land for many years. The trees which have yielded the average of 51½ nuts each per annum for the past ten years must now be about 15 years old. "Polgaha"'s own experience is of special interest; he gives returns for two best fields on a valuable plantation, and the result is an average yield of 47 to 48 nuts, while the profit in a good year like 1892-93 reached so satisfactory a figure as R130 an acre. What more could be wished? Tea, no doubt, in special cases does better; but considering the comparative permanency of the two industries, such coconut land, we suppose, ought to be worth double the value of tea land yielding the same profit per acre? In this connection, we call attention to the information respecting the use of coconuts in Uva afforded by our correspondent "Viator."

HINTS TO THOSE ABOUT TO OPEN LAND UNDER COCONUTS.

Suitable land for coconuts having been purchased, it would, in my opinion, be very unwise to commit the common error of clearing it at once. One's first care should be the selection of nuts from well-grown, healthy trees whose branches do not droop or show a tendency to fall-off prematurely; the nuts should be large and heavy with a full kernel. So strongly am I of opinion that a careful choice of nuts is most essential, that I would recommend paying R10 or R15 more per 1,000 than the rates ruling, in the districts where you buy, for the privilege of being allowed a free hand in their selection. On deciding what nuts will suit you, send your men once a month to pick one bunch from each of the selected trees; and when picking, each bunch must be lowered to the ground by means of a rope, or the nuts picked separately and dropped down one by one carefully.

When you have the requisite number of nuts for the acreage you intend opening, prepare you nurseries; the soil should be turned over well and burnt before levelling. Set the nuts close to each other, and in a slanting position; shade them from the sun, and water during dry weather. The nuts will germinate within four months from date of putting down, and if at the end of five months there are any which show no signs of growth, reject them, for they will never make healthy trees. When the seedlings are from 2 to 2½ inches high, transplant them at intervals of 18 to 20 inches in another nursery, where they would have more sun; ashes applied lightly after transplanting will help the growth of the plants greatly. The plants when twelve months old will be big enough to put out into your clearing, and sufficiently strong to withstand the attacks of white ants, one of the most formidable of enemies of the young coconut plant. On removing the plants from the nursery, carrying them by their branches must be strictly forbidden, as want of care in this respect is very likely to result in injury to the "cabbage." May being a wet month is the time of the year for planting.

In getting your land ready do not stint money on holing, the holes should be cut 3 feet square and 3 ft. deep and lined 26′ × 26′; burn as much wood and rubbish as you can get in the holes, and fill in with surface soil till they are 18″ deep when you should put down your plants, after trimming the roots carefully, and press the earth down firmly round the nut. In undulating land terracing is very desirable, while all ant-hills should be levelled to the ground and the earth from them applied to the adjacent coconut trees. There are 66 plants to the acre, but in your nursery it will be as well to allow an average of 80, so as to provide supplying vacancies caused by drought, white ants, beetles, lightning, &c.

After planting give out your land on contract to native cultivators (goyiyas) for three years for the purpose of raising potatoes, cassava, &c.; in return for your granting them this privilege they must keep the coconut hole free from weeds and grass and if they fail to do this they must submit to the forfeiture of one-half of the crops they raise. The goyiya must also undertake to report the destruction of any plant, so that the vacancy may be filled immediately after the first rains. No vacancies should be allowed to remain unsupplied, as a property is greatly lowered in value by the presence of gaps.

As I have said the ills a coconut property is heir to are:—drought, white ants, beetles and lightning.

Of *beetles* the worst is the red kind (Sinh. *Kandapanuwá*). Any tree attacked by this fearful pest must at once be rooted out, chopped into pieces and burnt without allowing any of the insects to escape; the remedy here is very drastic, but there is no other, and if the one I advise is not adopted the result will be the scattering broadcast of a perfect army of destroyers to ravage not only your own, but your neighbours' estates. I have myself made it a point to find out and burn trees attacked by *Kandapanuwá* anywhere within two miles of my property; when a case is brought to my notice I send my own coolies to the spot to cut down and burn the tree, and as compensation for saving my neighbour further loss I make him a present of 50 cents!

When a tree has been partially struck by *lightning*, steps should at once be taken to bleed it and the surrounding trees by boring holes at their bases with an auger, by which means a large percentage can be saved. Any tree, however, that has been irretrievably struck by lightning should at once be cut down and burnt to prevent the breeding of *kandapanuwá* within it.

Drought.—I do not water any plants when they are once put out in the field; they should be planted during the May rains. I only water them when they are in the nursery, and the plants are generally one year old where they are put out.

Again I lose very few plants by *white ants*; there are sometimes places where they destroy them often, and in such places I put in 2 year-old

plants. Be careful in such holes not to allow any grass or weeds to be put in when filling them up.

I may mention that there are about 30 different kinds of coconuts, and I do not, as a rule, prefer to get nuts for the nursery from any one district. I have seen very good nuts got from Veyangoda, from Negombo, Mirigama and Colombo. I get them from selected trees, not younger than 20 years old: let the nuts be large and heavy, as I said before, with a full kernel.

In reply to the question as to the average yield of a coconut tree, I may mention that during my experience I have seen trees which have borne 100 to 150 nuts each per annum; the yield, of course, depends on the nature of the soil, the locality and the manner of cultivation. I have recently visited an estate of about 150 acres in the Chilaw district which I valued at R1,000 per acre, and I was told by the owner, who has refused an offer of R1,200 per acre, that he gets over 100 nuts per annum on an average from each tree.

Land cleared and planted by me in May 1887 is now in partial bearing; 200 trees have borne a crop, from which copra was made and sold.

Kandangomuwa, Mirigama. W. H. W.

THE JUDICIOUS USE OF MANURE.

For the benefit of such coconut estate owners as are sceptical of the profitable results which follow the judicious use of manure, you are at liberty to publish the annexed statement showing the yield, during the last 4 years, of two of the best fields on a coconut plantation of about 200 acres in extent, in the Western Province, the soil of which naturally a poor light sand, more suited to cinnamon than coconut, has been much ameliorated by cultivation and liberal manuring.

STATEMENT REFERRED TO.

Field A—extent 15 acres.

Trees in full bearing, about 45 years old ...	1,123
„ partial bearing, 12 to 15 years old ...	142
Total trees... ...	1,265

Field B- extent 10 acres.

Trees in full bearing, 15 years old ...	658
„ partial bearing, 12 to 15 years old ...	66
Total trees ...	724

Fields:	A.	B.
In 1889-91 ...	52,322 nuts.	3,122 nuts.
„ 1890-91 ...	65,055 „	6,329 „
„ 1891-92 ...	60,650 „	2,382 „
„ 1892-93 ...	65,321 „	8,025 „
Total ...	243,351 „	19,858 „
Average for 4 years. ...	60,837 „	4,639 „
Per tree per annum ...	18 „	17 „

The gross return from the larger of these fields in 1892-93 was R2,751·47, and the cost of production per 1,000 nuts R12·15, leaving a net profit of about R130 per acre.—Yours truly,

POLCARPA.

(Answer to Criticism on above.)

Our critic unjustifiably suspects that "a rough and misleading guess" was made with regard to the extent of one of the fields referred to, which it is arbitrarily suggested is "nearer 20 acres than 15."

In drawing this conclusion two things are assumed: (1) that the trees in the field in question are planted farther apart than one would naturally infer from the figures given in the statement appended to the letter, and (2) that "Polgaha's" knowledge of the act of reckoning is too limited to enable him to calculate with any approximation to accuracy the extent of land covered by a given number of trees placed at certain distances apart from each other.

The reason adduced for the first assumption is that more than "84 trees to the acre would not be good planting" (I would fix the limit for "good planting" at 75); but the purpose of my letter and statement was not to show the results of good planting but to prove the profitableness of liberal manuring.

There was no guess-work whatever in the statement in question, and in describing field A as of 15 acres, I did so advisedly; the trees in this field as well as in the other referred to, are planted from 22 to 23 feet apart, and there are a number of young plants besides the bearing trees.

What manures to use and how to apply them have already been recommended by the best authority on the subject in the island, and if his advice be followed in the treatment of bearing trees and "W. H. W"'s instructions be attended to in the opening of plantations, even larger profits than R139 per acre may be calculated upon with the rates now ruling for nuts.—Yours truly, POLGAHA.

COCONUT LEAF DISCOLORATION (AND ALLEGED DISEASE) IN CEYLON.

KANDY, April, 20th, 1889.

I beg to report that I visited Veyangoda on the 27th March, spending part of the 27th and 28th in enquiring into the subject of the 'disease' affecting the coconut palm. In certain areas in Veyangoda I observed that the trees were in a very backward condition looking sickly and parched. I brought away with me leaves from affected fronds, and examined the discoloured portions of these leaves under the microscope at the School of Agriculture. [This instrument was neither complete in its fittings, nor powerful enough for the examination of minute fungi.] I was, however, able to discover a parasitic fungus in the specimens I brought away with me.

I had hoped to be allowed sufficient time to carry on my enquiry into the subject more thoroughly than I have done, using what intervals of time I had to spare, and availing myself of extraneous aid offered me in the matter of getting at better microscopic appliances.

I have, however, been able to visit districts where coconuts are cultivated both far from, and near to, the coast, and to note the different modes of cultivation and treatment of the soil adopted in the various plantations; and I have no hesitation in saying that thorough cultivation is the surest way of combatting the evil. Where the trees have been helped to maintain their vigour the affection was at a minimum, and in places where I would have expected to see the trees badly affected, but whereas though cultivation as one would have expected to find in the best agricultural districts in England, was adopted, there was hardly any indication of the 'disease' to be noticed. In areas where the attack was at its worst the soil was generally not in a condition favourable to luxuriant growth. A favourable chemical condition of soil is correlative to a good mechanical condition produced by working, liming, draining, &c. Thorough, deep cultivation must be adopted in soils inclined at all to be heavy—even at the risk of temporary loss, followed by liming—and if necessary—manuring.

Deep draining is especially necessary for heavy soils. No one who has seen these operations carried out under necessary conditions, and seen their results, can doubt their efficacy in preventing those conditions in the crops grown which favour attack from fungoid and insect pests.

Now in enquiring into the cause of a weakly growth, I would enquire first, whether good "seed," from a healthy and well-developed stock was used, whether the planting was properly done, and whether the crop has been well treated. It is difficult in the case of a perennial like the coconut, to get at the remote antecedents of the plant, but to anyone coming from a country where the art of agriculture is practised to perfection, the niggardly treatment of the soil, and especially coconut soil, in the generality, is most striking. Where the advantages of a fallow or a rotation are shut out, it behoves cultivators of coconuts to use every artificial means of maintaining the fertility of the soil. As exceptions, I have seen coconut estates under a very perfect system of cultivation, and as I mentioned before, they showed no indication of suffering from 'disease' the plantations were, moreover, on a comparatively stiff soil, and at a distance from the sea. I cannot agree that salt, and salt only, is necessary to raise the affected coconut tree to a healthy state, but I do not mean to underrate the value of salt in coconut cultivation; and I may here state that a supply of salt under easier conditions, but with what precautions may be thought proper to preclude it from being used for culinary purposes, is a great desideratum. But it must be remembered that the use of manures must follow cultivation of the soil: and in heavy soils, without thorough deep draining, the advantage of manuring are nullified. Then all these operations so necessary to a soil continually growing the same crop, must be regularly and systematically carried out, not in patch-work style. No experiment is required to prove their necessity. Results must be waited for: it will take time under the effects of previous ill-treatment.

An outlay of capital is, of course, necessary, but the increased returns, and the resultant vigour of the tree—enabling it to withstand attack, will more than repay this outlay.

C. DRIEBERG.

SUPPLEMENTARY REPORT.

In sending out this Supplementary Report on the Coconut Leaf Disease question, I need not apologise for the delay in its appearance, for those who understand the nature of such an enquiry will admit that it must be based on close observation, and entail time sufficient for examination of leaves and of soil, for watching phenomena as they occur in time, for observing the effect of changes of climate and temperature, for enquiring into the history and progress of the plantations, and gathering a vast amount of information regarding various estates. I have spent much time in this, but no more than was necessary to enable me to come to the conclusions I have arrived at. During the past nine months I have, through the courtesy of estate proprietors and lessees, been enabled to visit a number of estates with the object of making observations, and of gathering information which they were only too ready to give me. I take this opportunity of recording my gratitude for the help they afforded me in this way.

But perhaps I owe an apology to many who will read this report for entering too minutely into the chemical aspect of soil cultivation and plant-growth. Many are perfectly conversant with the facts.

Since my first report, however, questions in this connection have arisen in the columns of the daily press, and discussions have been carried on agricultural chemical subjects, involving points that were scarcely fairly stated. I had neither the time nor the inclination to take part in these discussions, but at the same time, feeling it my duty to in some way help

towards the clearing up of some of the points that have arisen, I take the opportunity of expressing my views, in this report, for, as a matter of fact, the questions at issue, are closely connected with the subject of the proper cultivation of coconuts.

I have endeavoured to summarise the discussion as much as possible, and at the same time to note the weighty opinions of men who have had long experience in coconut cultivation; and the conclusions I have arrived at are, as I hope to show, in accordance with the ideas of both practical and scientific men of repute.

Public attention was first drawn to coconut-leaf disease in Ceylon in a letter from the Veyangoda correspondent to the "Examiner" in its issue of the 31st January, 1889, when it was thus described: "It (the disease) is first observable as orange-coloured spots on the leaves. No fungoid growth is observable by the naked eye, only the discoloration of the leaf. As time wears on the orange-coloured spots dry up and are of the colour of withered leaves. Some fronds are so severely affected as to die off, and in these an ashy substance very like fungus is observable by the naked eye." Specimens of leaves with the disease were forwarded to Dr. Trimen, Director of the Peradeniya Gardens, who, after a cursory examination, gave it as his opinion that "their appearance suggests a failure of proper nutrition;" he would "look to the roots and the soil for the cause." "I cannot but think," said Dr. Trimen; "that these (plants) after being grown under some incongenial conditions, . . ." "one requires to know the history and surroundings of the plants themselves and watch their progress for some time." The Veyangoda correspondent writing of this opinion of Dr. Trimen makes the following statement:—"In support of the theory of innutrition there is the fact that the severely-affected plants are invariably the weakly ones; *per contra* all the weekly plants are not affected." The former statement is an important one, and the conclusions to be drawn from it are in no way affected by the latter. I hold, and I trust I shall make it clear further on, that it is the fact of a tree being insufficiently nourished that brings it under the influence of those agents, the effect of whose work is seen in coconut-leaf disease.

In an article on "Salt in coconut cultivation" published in the "Examiner" of February 21st, 1889, the theory put forward by the writer "B" is that trees are possibly suffering from the absence in the soil of salt, or from its presence in too small quantities. This I consider very improbable in an island of the extent of Ceylon, which moreover comes under the influence of monsoon winds. Again, there is the fact that a good many trees were affected and badly affected by "by coconut-leaf disease" on the sea-borde. Quite lately the same writer made the statement that the application of salt to badly-attacked trees resulted in no beneficial effect, in fact that it aggravated the attack.

In the "Examiner" of the 22nd February, 1889, the Veyangoda correspondent gives the opinion of "perhaps the most intelligent and practical planter engaged in the cultivation of coconuts" to the effect that trees are suffering from an insect attack, that the juices of the trees are weakened and diseased by want of nutrition, and that innutrition is due to the hard and impervious nature of the soil at Veyangoda (where the attack is prevalent in its worst form). This opinion is, in the "Examiner" of March 5th, 1889, said to be that of Mr. William Jardine of Golua Pokuna estate, Kadirana.

Of the salt theory propounded by "B.," Dr. Trimen says:—"I scarcely think that the mal-nutrition of your trees to which I attribute the dead spots in the leaves—is due to want of salt in the soil; unless indeed the land where they grow is quite abnormally wanting in this almost invariable constituent . . . I should rather look the physical properties of the soil, and especially the drainage. That the mortified spots may be set going in the first instance by the punctures of a minute bug is by no means improbable. So far as I have seen, I am not disposed to consider

these spots a very alarming phenomenon. They are pretty frequently to be seen on all palms if not in quite a healthy condition, and I quite expect that under a more liberal treatment they will cease to appear.

"W. J." recommended the following treatment to raise the conditions of the trees so as to cope with the disease: "Stiff and clay lands should be broken and turned over in clods to a depth of fully eighteen inches by means of strong steel-bladed picks, afterwards treated with 30 or 40 bushels of freshly-slaked coral lime to the acre scattered broad-cast and allowed to be washed in by the rains. The clod would permit of free aeration, and all the rain would be absorbed and percolate through the soil, instead of as at present, more than one-half being lost owing to the impervious condition of the soil." I cannot pass over this recommendation without a word of support. The niggardly treatment which coconut land generally gets, as to the working up of the soil, cannot but tell disadvantageously on the crop. No amount of "trenching," as I have seen it done on some estates, will compensate for this neglect. This thorough working up of the soil, while it has all the advantages of draining, at the same time facilitates the preparation of plant food. The soil will then be able to draw its moisture both from above and below. The suitability of thorough drainage for coconut cultivation has been questioned.* It is against the principles of agricultural chemistry that a tree whose roots rest on a water-logged strata should thrive for long. The sickly appearance of trees growing under such conditions is quite a common and familiar sight. It is absurd to point to a solitary apparent exception to this rule, and, clinging to it, lose sight of facts founded on laborious scientific research. This mode of argument, characteristic of a warped judgment, is most unsatisfactory to meet. Water may be present to the roots to any extent, but the necessary condition is that it should should not be stationary. On the sea-shore we see the roots of the coconut palms continually bathed with water, but the texture of the soil is such as admits of its ready percolation. Thorough draining not only relieves a soil of excess of water, but paradoxical as it may at first appear, it greatly mitigates the effects of dry weather; when soil is drenched with water, and dried by evaporation, it becomes hard, especially if it be of a clayey nature. Land that is dried by drainage is absorptive and retentive of moisture dropped by dews and acquired from the atmosphere; while the soil deepened by drainage or deep cultivation permits the crop to put forth stronger and healthier roots, and thus becomes secured against drought. The most successful estates I have looked over have received the treatment which secures such results. I observe that within the last year the thorough working up of the soil is being adopted more generally, but the benefits to the tree to be expected in this case will have to be waited for. This mode of treatment must be considered a matter of routine at such intervals as may be thought advisable.

It is no argument to say that because the necessity for such cultivation has apparently not been recognised hitherto, therefore it cannot be recognised now. In America, once on a time, corn grew and gave large yields year after year with little attention and care, but the time came when this manner of cultivation was no longer admissible, for whatever the crops cultivated, it is plain that continued cropping without proper cultivation and the use of manures must ultimately

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* In the "Examiner" of Sept. 10th, 1889, the Veyangoda correspondent says that having occasion to drain deeply a bit of rich clayey land on which coconuts did not make the growth that one can reasonably expect of them, more especially as that particular patch had received very generous treatment, he was surprised to find very little root growth, a marked absence of feeding-roots, and most of the roots rotted. This was an opportune bit of experience,

bring us to a time when the crops grown will no longer pay the the cost of cultivation.

As I mentioned in my first report, there is some considerable difficulty in getting at the history of the various plantations, affected and unaffected, but during the time that has elapsed since I wrote, I have been able to gather a good deal of information of this nature, in most cases from those who had a personal knowledge of the facts. I do not intend to mention the names of any estates or even indirectly indicate their situation, for I do not consider it fair (being convinced of the predisposing causes of the disease) to make disclosures regarding the history of any private property in a public report. I am thoroughly satisfied in my own mind that where I have seen the disease in its worst form, there was always an antecedent of bad treatment, whether from sheer neglect, from motives of economy, from the use of bad seed-nuts and careless planting; or, on the other hand, there were natural disadvantages. For while a soil can be made fertile by much mechanical labour and the addition of such substances as it is deficient in, if this cannot be done except at a cost as great as, or greater than, that for which fertile soils can be procured, the soil may be regarded as practically worthless. I have during my observations seen soils that illustrate all these conditions either singly or in combination.

The circumstance that the mechanical condition of the soil, where the trees show the attack, is favourable, is not sufficient for healthy growth. It may occur that though the mechanical condition is not of the best, there may be present in the soil a sufficiency of soluble plant food for a certain period; but, on the other hand, though the mechanical condition may be of the most favourable nature, it is quite possible that most of the mineral constituents may be of the most insoluble kind, or of a perfectly useless nature—the necessary mineral ingredients of plant food being absent, such results depend on the origin and history of a soil—not only on its derivation from particular rocks, but its modification by the natural agents, chemical, mechanical, and animal. If it can be proved that the chemical condition of a soil is faulty, that it lacks or is deficient in one or more of the elements of plant food, while the growth on it is healthy and vigorous, then can it be said that the principles of agricultural chemistry are unsound; while the same conclusion may be reasonably come to, if while both the chemical and mechanical conditions of the soil are favourable, the growth is weakly and unhealthy—of course assuming that the selection and planting of seed nuts were well done.

The existence of isolated areas of unhealthy growth must be accounted for as being caused either by unfavourable chemical conditions, or by peculiarly uncongenial mechanical conditions of soil, possibly by an unsatisfactory substratum, or again by carelessness in selection or planting or seed nuts, or lastly by neglect for any period, especially during the early stages of growth. As I have stated before, a tree which has up to a certain period appeared healthy and robust may begin to exhibit unhealthy symptoms from a deficiency of plant food, or moisture (possibly induced by a spell of prolonged drought—for water is necessary not only for the assimilation of food, but also for its elaboration and for the circulation of sap). This failure in very limited areas—more limited than in any coconut plantation—is often met with in coreal, root, vegetable and garden cultivation, and special treatment in various ways is necessary where the planting and seed are not at fault; such as improving the mechanical texture of the soil, adding either a material such as lime which liberates plant foood, or some manurial substances. In certain cases a previous vegetable growth may account for the exhaustion of particular elements of plant food. It is on consideration of these causes of failure in cultivation that one is impressed with the need for caution in the

selection of a property; and where one proprietor has had the opportunity of selecting his own seed-nuts, watching their growth in the nursery superintending their planting out, helping their start in the field under the most favourable conditions, for care during the early stages life whether of the plant or animal is of primary importance for healthy development in after life- it is here that he has the advantage over another proprietor who takes over his estate ready planted. Hence the importance of a careful enquiry into the history of soil and crop to ensure a safe investment, especially in the case of trees of a perennial character. This is too much lost sight of. Often after-care and liberal treatment will improve the condition of trees, and this no doubt many have found by experience, can frequently be successfully done; but as before mentioned there is a limit, and if the effort at improvement entails a cost that is not commensurate with the returns that may be expected, then such a property must be considered a failure. I have in view an extreme case of this nature of an estate most perfectly planted and liberally treated, which every attempt to improve without incurring financial loss, has signally failed.

There have been reports from abroad of coconut trees affected with disease. In an article by the Hon. B. Howell Jones, which appeared in the "Journal of the Royal Agricultural and Commercial Society of British Guiana," reference is made to the disease affecting coconut trees in Mahaicony, thus: "Here and there we saw signs of an inexplicable coconut disease, not to be confounded, with the attack of the beetle, and on talking over the matter, both Mr. Smith and Mr. Mastard were of an opinion that it results from the planting of green nuts which grow much more rapidly than ripe ones, and that after bearing one or two crops they seem to get exhausted and die away." Mr. Quelch, curator of the Museum and Editor of the abovementioned Journal, writes me that that the disease in British Guiana is evidently identical with that in Ceylon, and that it is now manifesting itself by a dropping of the half-ripe fruit and branches. I have observed this result in some parts of the Island where the attack is bad. The opinion recorded by the Hon. Howell Jones is worthy of consideration. The growth from an immature nut cannot be expected to be a healthy one; but whether the nut or the soil be at fault, it must be borne in mind that the disease is associated with an unhealthy growth. "The disease," says Mr. Quelch, "*is* common on the different parts of the Cocals, but it does not seem to spread to any alarming extent."

Mr. J. H. Hart, Superintendent of the Botanical Department, Trinidad, referring to the coconut palm disease in the West Indies, and distinguishing it from the attacks of beetles and scaly blight, says that traced to its primary source the disease would appear to be caused by a state of semi-starvation induced either by drought or a deficiency of manurial constituents in the soil of the particular district, and that where these causes do not obtain it disappears. In my own experience I found this to be the fact, for during my visits about the middle of last year I found certain estates suffering from the effects of the prolonged drought which then prevailed, and showing much discoleration of leaf. but with the return of the rains and the measures taken to combat the evils arising from a lack of moisture, these effects have ceased to appear. On other estates, however, the disease does not show any signs of improvement, and in such cases I cannot but agree with Mr. Hart that the want of a sufficient supply of plant food is the origin of the evil.

I am indebted to Dr. King, analyst to the City of Edinburgh and the leading Agricultural Chemist in Scotland, for help in the matter of soil analyses for which I had no appliances at the Colombo School of Agriculture. Mr. John Hunter of the Minto House Chemical Laboratory referring to the analysis of a mixed sample of soil and sub-soil from a part where the coconut trees are most affected with disease, say: "You will notice that the soil is *very* low in phosphoric acid, and low in potash;

there is an abnormally high percentage of oxide of iron and alumina .... I may say that a soil recently analysed here contained more phosphoric acid than your sample does, and yet was incapable of raising a healthy crop." Here I consider we have a flood of light thrown on the subject. The well-known maxim of Playfair that "it is the body *in minimo* that rules the crop" instantly suggests itself in this connection. It may be that phosphoric acid and potash are present in the soil, but not in a condition available as plant food, and here it is that the importance of the operations which favour the liberation and distribution of soluble plant food comes in, for a soil may contain an abundance of phosphoric acid, potash and magnesia, and yet be infertile if these exist as apatite, felspar and serpentine. It is needless for me to cumber this report with suggestions as to the best means of supplying phosphoric acid and potash to the soil in a manuriat form; let me only remined owners of estates that they should use the most soluble manures, containing these foods if they look for early results, and if they wish to come to the aid of their trees before long - as they should. I mention this because I know of cases where manures are being applied in a most insoluble and almost worthless condition.

But on the texture of the soil depends its powers of absorbing and retaining manures. Now the fact that there is an abnormally high percentage of oxide of iron would seem to indicate that more thorough draining and working up of the soil would tend to a better balancing of the proportions of plant food. I am aware that the soils in many parts of Ceylon have very large proportions of iron oxide, as analyses I have before me show; but in the case in point, this preponderance of iron oxide is to be considered together with the abnormally low percentage of the most valuable mineral food ingredients of plants. Certain of the compounds of iron we know are noxious to vegetation, while "reverted phosphate" of iron, as such, deprives the land of more soluble phosphates which might otherwise be found.

Here I must support the recommendation quoted in the early part of this report, that lime should be applied to the soil of these infected areas. Not only will lime act mechanically and improve the texture of soil, which being made more porous is better aërated, but it supplies a base which forms soluble salts, and thus liberates plant food. If I remember aright, it has been reported in the newspapers that an experiment with a dressing of lime to affected trees did improve their condition.

Where the balance of nature has been disturbed, and one crop has been selected for a particular area to the exclusion of all others, contrary to the course of nature, it is but natural to expect that the soil must eventually fail its supply of certain ingredients of plant food, and this more especially where the soil is not of the most fertile character, when the same food ingredients which the crop most affects are continually being drawn upon. Even where in a state of nature one crop is confined to restricted areas, we know that there is such a thing as a natural course of rotation, and one crop gives way to another: this has been recorded in the case of natural forests of trees.

What is of great importance is that the feeding habits of cultivated plants and trees should be thoroughly understood from experience and the results of analysis, and that plants and trees should be so treated by cultivation and manuring as to ensure a sufficient supply of the food ingredients necessary for their healthy growth. Of course there are special circumstances such as the occurrence of long droughts which are practically beyond the control of cultivators, and these have to be dealt with as well as possible so as to mitigate their effects. I have examined some roots dug up from an infected area, which appear to have a tendency to die off, but have not been able to note the presence of any organism which

can account for the result. It accounts for the withering tendency of the roots as the result of those causes which bring out the weakened condition of the tree, and especially a lack of sufficient moisture.

The term coconut leaf disease as used in Ceylon I consider incorrect in its application. It has been indiscriminately applied to every form of discoloration on the leaves, of whatever nature. Now there are some discolorations of a withered appearance resulting from the puncture and sucking of minute insects, and these are often seen in healthy trees, the discolored patches being distinct in outline surrounded by a healthy growth, while the trees are not in any way affected in health. Those, however, occurring on weekly trees are the nuclei from which decay spreads to such an extent as to seriously injure the health of the trees. Again, there is the appearance of yellow discolorations either as spots or all throughout the leaf resulting from a failure of the leaf to elaborate chlorophyll, and this cannot but be the result of innutrition (where the leaf is not with ring in its natural course). In weakly specimens I also found the presence of a fungus presenting to the naked eye a turgid brown discoloration in the leaf tissue, but I am convinced that there is nothing to cause any alarm in the occurrence of the fungus which from its nature need not lead to suspicion of its spreading, or indiscriminately attacking coconut palms.

There have been various means suggested for scaring away insect pests, whether fly, beetle or bug, which it is needless for me to repeat here, but keeping the land clean is of primary importance in bringing about this result. The unsatisfactory condition of the soil as shown by analysis is a matter that must command the attention of those whose minds are exercised about this so-called disease. Sir John Lawes, the greatest living authority on agricultural matters, says: "I consider that plants are liable to be attacked by fungi, parasites, &c., in proportion as the soil is deficient in available mineral food. . . . The greater the amount of mineral matter at the disposal of the plant, the greater would be its power of resistance."

I consider that there is no cause for alarm about the so-called Coconut Leaf Disease to those who are cultivating their lands after the most approved methods. The idea that danger or destruction is threatened generally by a fungoid attack must be put away. The consensus of opinion, and notably that based on analyses of soil, tends to prove that those areas where the disease prevails to such an extent as to disquiet the minds of proprietors and lessees, are suffering from an impoverished condition of the soil so far as the successful growth of coconuts is concerned: and to cope with the disease the soil must be by every available means — which I have endeavoured to indicate—raised to the required standard of fertility.

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SPECIAL REPORT ON OILS AND FATS OF CEYLON.

BY LEOPOLD FIELD, F.R.S.E., F.C.S.A., LECTURER AT THE HEALTH EXHIBITION, 1884.

The chief, indeed the only fixed, oil of Ceylon with which English manufacturers are commercially acquainted, is coconut oil. This comes into the British markets as a solid, of nearly the consistence of tallow, liquid coconut oil being understood by those who order it to be the portion expressed from the solid, equivalent to the olein or tallow oil as related to stearine.

is not necessary to say much about the application of so well-known stance as coconut oil, except to point out that, in the very able published by the Ceylon Committee at the Colonial Exhibition, a n error has been made in supposing that coconut stearine is used candles." The original composite candles of Price's Company, it is were manufactured of coconut stearine, but I believe are almost t now. Belmont sperm *may* have been once made of that material, rtainly not for nearly thirty-five years, as *Mr.* G. Wilson, in 1852, ing before the Society of Arts, gives the composition of Belmont candles as hot-pressed *palm* acid.

at Price's Company make their "New Patent Night-lights" entirely essed coconut oil, and these are superseding the old "Star" and ds" night-lights hand over hand, the light, whiteness, and cleanliness e coconut oil, and the replacement of the greasy paper-case by a , quite accounting for the public preference. In soap, also, coconut s very largely consumed, though far less in England than on the nent.

and to this point, perhaps, the preference is to be attributed that is in the English market to Cochin over Ceylon oil. It does not appear generally known at the source of supply, but a glance at the market lists will show that the former rules 5*s.* to 6*s.* over the latter. And, d, the distinction is no fanciful one, for the writer's experience has n that the brands *known as Ceylon* here are not suited for fine night- or soap manufacture, on account both of colour and smell. Whether worst parcels from both countries are labelled Ceylon, and the best in, irrespective of their source, is a question for others to determine. well though that this difference of reputation should be pointed out.

Stress may also here be laid on the ease with which a good coconut may be made. It is very surprising that the sources of supply are lly ever prone to manufacture their own produce. Yet, an iron pan a little fuel with cheap caustic soda, and facilities for tons of soap are e. In a country where, besides coconut other equally valuable saponile oils abound, with colouring and scenting materials ready to hand, it is e remarkable that soaps, far better than the trash which Germany has poured into England, should not be turned out at a high rate of profit. writer would guarantee, with the materials alone which the Island ld place at his disposal, to turn out soap that should rival some of the ling English brands in all respects of scent and appearance, and with a le foreign assistance, of use as well.

Of the various *oils* which the kindness of the Commissioners placed at disposal, the writer can give but a cursory account, the quantity being small, and the composition so entirely unknown. In fact, of *none* of m had even the name reached his ears before, though scarcely an oil ches England but sooner or later passes through his hands.

Margosa Oil (sp. gr. 910) has too strong a smell (intensified by saponiation) to hope for toilet success. Its medicinal properties should, however, procure it a name, if backed with sufficient authority and introduced ler good auspices.

Punai Oil.—This gave an excellent soap, curiously enough of a deep *low*, not expected from the dark *green* oil. The disagreeable odour nished entirely upon saponification. If the price be within range, there uld be a future for this oil.

Illupai Oil. This oil, of an almost pure, white, and in consistence and lour much resembling coconut oil, is decidedly the most valuable of all e new oils examined. It saponifies readily, and gives a fine hard soap. s adoption will depend solely tho upon price.

Kekuna Oil, known as candlenut oil, yields a magnificent, firm, lathering soap. Mixed with one-third *gingelly* and one-third coconut oil, and saponified with caustic soda, slightly potassiferous, soap is formed second to no *animal fat soap*. A great advantage of vegetable oil soaps is their freedom from *smell*, especially that highly objectionable smell that is evolved some time after saponification from tallow and lard curds, &c.

Castor Oil.—It may here be mentioned that castor oil has of late years been enormously employed, in conjunction with coconut, in the manufacture of cheap transparent soaps. Alcohol being so plentiful in Ceylon, there is scope for making a magnificent soap of this class, especially as castor oil is readily procurable, and *sugar* is very cheap.

Essential Oils.—All the varieties produced in Ceylon are so thoroughly well known that it is superfluous to dwell on them. The suggestion, however, might be made, that other at present non-indigenous scents might be profitably cultivated, and thus relieve the redundancy, the plethora of citronella, lemongrass, and cinnamon. Cinamon leaf is receiving much attention of late as a fine substitute for cassia, and doubtless will be much used in future.

The spirit, treble distilled from arrack, has a peculiar bouquet, which, in the hands of a skilful perfumer, could be made to blend well with the various finer essential oils, (such as ylang, &c.) afforded by the Island. Eau de Cologne owes its peculiar charm to the presence of œnanthic ether from the grape spirit of the Continent. Why should Ceylon not produce an equally fine perfume from her own spirits and essences?

To conclude. It appears to the writer that the energies and skill of the Ceylon manufacturers should be directed, not so much to the production of more of their present goods, but to the culture of new and favourite products, and the direct conversion of these new materials into commercial wares for the retail consumer.

SKETCHES OF THE INDIAN COCONUT TREE.

Cocos Nucifera (Linné.).

By M. Jules Lépine.

(Translated for the "Colombo Observer" (now "Ceylon Observer") from M. Paul Madinier's "Annales de l' Agriculture des Colonies." No. 7, April 15.)

Among the trees of the regions between the tropics, the first that attracts attention is, without contradiction, the coconut tree: none can compare with it in elegance of form. Its trunk, straight and shooting upward, is from 30 to 50 centimetres [10 to nearly 20 inches] in diameter, and attains the height of from 20 to 30 metres [from 60 to 90 feet]: it ends in a *bouquet* of leaves of which each leaf is not less than from 4 to 5 metres [13 to 16 feet] in length. The flowers are arranged in clusters; each cluster bears from 5 to 15 nuts of the bigness of a man's head. Nothing equals the admiration of the voyager who, after many months spent at sea, beholds rising before his eyes one of these islands covered with coconut trees such as one meets with in such plenty in the Pacific Ocean. But if this tree has no rival in beauty, it may also be affirmed that it is one of the most useful which exist in the hot regions of the globe. Without it how many countries would remain uninhabited! Let us admire the sovereign wisdom which presided at its distribution, and thank God for having provided so well for its dissemination, that without the aid of man, this precious vegetable naturalizes itself on every land which arises out of the ocean. If we sum up the uses of the coconut tree, we see that its foliage affords a defence from

the rays of the sun; that its wood, although of a feeble and short-lived tissue serves, for the construction of such shelters as in many countries Europeans would not venture to call houses, but which enjoys nevertheless the privilege of lodging the natives. The leaves, when woven, are in daily use, in many other places as well as in India, for the construction of light roofing. Baskets too are made of them; their petioles or leaf stalks are used as fuel; the fibres of the leaves bound together serve for brooms; in Oceania they use them for the purpose of illumination, preparing them with the nut of the Aleurites. The outer covering of the fruit furnishes fuel; and from the fibrous husk which covers the outside of the nut properly so called are extracted very strong fibres which are used for a variety of purposes; ropes of great strength and of considerable duration are formed of it; no other vegetable fibre resists for such a length of time the alternations of dryness and humidity. The woody portion, or shell, which protects the kernel, is used in the construction of various table and kitchen utensils, its use to engravers is well known, and an excellent charcoal is obtained from it. A young cocoanut contains a liquid of a slightly opaline transparency, of an agreeable flavour, and is a valuable resource in countries that are not provided with good water; the kernel itself constitutes a wholesome and nutritious food. The water in a ripe cocoanut is sweeter and somewhat acidulated; the hardened kernel contains abundance of oil; although in that condition it is still fit for food, yet it is chiefly used for the extraction of oil. From the peduncle or flower-stalk or spadix, as soon as it expands,* they extract, by cutting the extremity, a very sweet liquor called *callow* [toddy]; by preventing its fermentation and by evaporation, is obtained a sugar which, after being refined, is the same as that of the sugarcane. The *callow* is the daily beverage of the Indians; they drink it almost always fermented in place of wine. If the fermentation is suffered to proceed too far, the result is vinegar. The fermented liquor being distilled produces arrack. The central bud, if you disregard the loss of the tree, affords, under the name of the *cocoanut cabbage*, a very delicate eatable, which is taken in the shape of salad, pickle, &c. In fine, the cocoanut tree can afford clothing, for the tunics which envelope the base of the leaves are real tissues, which, when sewed together, form bags, and in some countries, contribute towards the clothing of the natives.

There are poetical descriptions of the cocoanut-tree; botanical works describe it minutely; and some publications have been issued, containing descriptions of the produce of this tree. It may therefore be supposed that nothing more remains to be said, and that the subject is exhausted. We are able, however, to affirm that our researches leaves still something to be published. Our design is to throw light on what still remains obscure in the cultivation of this plant, to make people better acquainted with the advantages thence derived, to lend assistance to the industry employed to its improvement, and finally, to rectify some errors which, remaining unrefuted, continue passing for certain truth. The cocoanut-tree was known from the earliest ages; it is described in Sanskrit works under the name of *nari* and *nari-kera*. The Arabians call it *jouz hindee* or *Indian nut*. It is probably the "*great nut of India*" which Sir John Mandeville mentions as the tree which produces nuts as big as a man's head. Fourteen kinds of cocoanut trees are known, of which thirteen are natives of America, and only one belongs to Asia. It is this about which we are engaged. Again, many authors are inclined in thinking that it may have come from America, whence the currents may have carried it to the Polynesian isles, and thence to India; but other botanists are of an opposite opinion who consider it as an Indian species which might, by degrees, have found its way to America and been naturalised there. What is its

* Before it expands.—COMPILER.

real origin? We do not venture on deciding this question. It has been always a fact, that the *cocos nucifera* is spread extensively over all the isles of Oceania, and that it is found in the Archipelagos where no trace of man has been discovered. It is met with equally in the isles of Indo-China, and of the tropics; above all, it is common on the Malabar Coast, in Ceylon, the Maldives and Laccadives, on the Coromandel Coast, and in the Bay of Bengal. This tree grows well on the coral islands, on the sea-beach, and at the mouth of rivers; it however ascends the Ganges to very great distances; it is found also in the interior of continents; in Ceylon again it flourishes on hills 200 metres [about 650 feet] in height. In many of the Polynesian islands, we have observed the coconut-tree diminishing in height in proportion to the elevation of the land, and never passing beyond an altitude of 200 metres, and often, in the intermediate stations, we have found it possible to pluck the coconuts with the hand. Royle supposes, that although coconut-trees are found growing, either spontaneously or by cultivation, in all the tropical regions of the earth, chiefly on the sea shore, that it is established on all the countries which have risen out of the sea. According to M. Marshall, its natural geographical distribution may be between the equator and the 25th degree of latitude. Within the Red Sea it advances as far as Mocha, and does not flourish in Egypt. In India, as in all those countries where the coconut-tree is cultivated on an extensive scale, numerous varieties are found which remain to be investigated. The natives of Pondicherry distinguish three principal ones. The *macaveri marum*, a native of the Nicobar isles; this variety developes itself more rapidly than the rest, but retains a small size and produces little. The *sevousolanir* differs from the type of the species in the fibrous envelope which is ruddy within; the *telly* of which the petioles and the nuts are yellow, the latter are round: the *souriacoudi*, of which the petioles are reddish. The parts of the coconut tree bear different Tamil names which it is useful to make known. The tree is called *tennamarum*; the fruit *tenga*; the juice drawn from the spadix *tennam-caton*; the terminal bud or cabbage, *tennam-kourto*; the coarse sugar obtained from the juice (jaggery) *penevellum*; the oil *tenga-yennei*; the water of the young coconut, *yelle-neer*; the fibres which surround the nut, *kair tennamar*; the dried kernel, *copra*, *copari-tenga*.

What conditions of climate are most favourable for this tree? What soil suits best with it? What are the requisite manures? How is it cultivated? Having examined the cultivation of the coconut tree, it is necessary to observe what are the natural conditions of its development. It is necessary to call chemical analysis to our aid; for if we knew what are the mineral salts which it draws up from the earth, and in what proportions we should have a precious guide both in the choice of soil and of manure. The coconut tree, we have said, is found in its natural state, chiefly on islands and on the shores of the sea; the ripe coconuts detach themselves from the tree, fall into the water in which their shape and their density allow them to swim, they are driven by the winds or hurried along by the currents of the sea until they are brought into contact with land, are wafted ashore, germinate, and become reproductive. It is worthy of remark that coconuts can remain a very long time in salt water without losing their germinating power. The kernel is found protected by a very hard shell, almost wholly formed of carbon it is impermeable by water. This shell is itself surrounded with a fibrous husk thick, and spread through a cellular tissue. The coconut according to some authors, demands a mean temperature of 22 deg. Centigrade [Fahrenheit 71·6]—according to M. Boussingault, he makes it a minimum of 35 deg. [Fah. 77 deg.] and a maximum of 28 deg. [Fah. 82·4 deg]; our own observations lead us to suppose that the minimum may be lowered to 23 deg. [Fah. 71·6] and the maximum carried to 33 deg. [Fah. 91·2 deg.], that the

medium of 26 deg. [78·1 deg. Fah.] is the one which appears most favourable. We see, in fact, that the numerous archipelagos, the temperature of which does not extend far beyond these limits, contain forests of coconut trees which attain very great heights, and which require not the care of cultivation, while in the countries which enjoy the maximum temperature of 37 and 38 degrees [Fah. 98·6 deg. and 100·4 deg.] the coconut trees require frequent irrigation, chiefly during the first years, and their development is very slow. Dry climates are prejudicial to them: they require both heat and moisture, and, on this condition, they flourish better, all other things being equal, in a country where the rains are frequent, than in one where it rains seldom. This tree requires a loose soil, its slender, horizontal roots often extend to the distance of 40 to 50 feet; they are formed of a ligneous body surrounded by a spongy tissue, and covered with a reddish epidermis; when the coconut tree is planted in a compact clayey soil, which retains water, not only are the roots prevented from spreading, but they rot; they putrefy equally in a sandy soil situated in a marshy valley. It succeeds chiefly in the sands along the seashore, or at the mouths of rivers; it requires running or agitated water, which, while it saturates the soil with moisture, conveys likewise to the roots the salts which are needed for the nourishment of the vegetable.

The coconut trees require air and light: they should not be planted too close to each other; in the coral islands, covered with sand, which are met with in Polynesia, if the coconut tree appears primarily, it takes possession of the soil; if, on the contrary, the larger vegetables make their appearance, and develope themselves previously to it, especially if these be the *casuarina*, in that case the coconut tree cannot develope itself, and the former vegetables retain the sole dominion. To this tree hurricanes are pernicious, since their tops afford an advantageous hold to the wind; if the latter be violent the tree ends by yielding in the scuffle, and when not laid prostrate, it does not come out of the conflict before its trunk has become inclined. In the Society isles, in order to propagate the coconut tree, they take a coconut that has dropped from the tree, cut off a slip from the envelope, and attach the coconut to the trunk of a coconut tree, at about 2 metres [6½ feet] from the ground, and leave it to germinate freely in the air and in the shade, under the influence of the rain and the moisture of the atmosphere. When the first leaves have burst forth, it is placed in a hole 40 centimetres square, covered up with earth, and the young plant is left to itself. In the isle of Kilton the coconuts are not transplanted, on the pretence that in this way they diminish in size but become more quickly productive; the coconuts are smaller, rounder and yield finer and stronger fibres. In Ceylon, when it is intended to make a plantation of coconut trees, the nuts are placed side by side, usually in squares of four hundred; they are then covered with 3 to 4 centimetres of earth and watered every day up to the moment the leaves are seen shooting out; the watering may then cease. Coconuts placed in the nursery in the month of October may be transplanted in January, those placed there in June cannot be transplanted till October; after the transplantation the young plants are watered for some months, but if this is in the rainy season the irrigation is useless. Each plant is surrounded with sand and salted earth, they are placed at 30 feet distance when disposed in squares, and at a distance of 27 in rows. On the Coromandel Coast, almost the same course is pursued as in the island of Ceylon; ashes are used as manure, a handful of salt is placed in the hole destined to receive the young plant; only with this difference, that the irrigation must needs be carried on for many years. Some cultivators leave no more than 15 to 20 feet between the trees, this distance is not enough; coconut trees thus planted produce less by half than those that are placed at greater distances. It is necessary to leave between the tree a distance of about

15 metres [46 feet]. During the first four or five years, greens, small grain, sweet potatoes, yams, chillies, &c., may be cultivated in the spaces between the young plants. On the Coromandel Coast, with the view of affording shade to the young plants, even plantain trees are planted; but this mode of cultivation is pernicious, since the plants have not enough of light, and the plantain trees exhaust the soil. At Pondicherry a coconut plantation having a surface of 53 acres 51 centiares and containing 100 plants, cost, in establishing and maintaining it for seven years a sum of 504 francs, comprising the tax paid during the lapse of that time. In the eighth year, and in the years following, the produce was valued at a medium of 150 francs; if the annual tax 65 fr. 75 c. be deducted, as well as the interest of the capital employed, viz: 50 francs 40 c., there remains a net revenue of 92 fr. 85 c. The coconut trees begin to flower about the 5th year; they bear during seven years, but it is not till the 12th year that they are in full bearing.

A coconut tree of about thirty years, having a medium height of from 22 to 24 metres and a diameter of 21 to 25 centimetres, presents as to its trunk, in dried matter, 180 kilogrammes [a kilogramme=2·20548 lb avoirdupois] which yield 15·441 kilogrammes of ashes; the dried roots afford 8 kilogrammes which yield 210 grammes [a gramme= 15·438 grs. troy] of ashes; the tree gives twelve leaves a year, which, multiplied by 30, gives us in dried materials 836·280 kilogrammes containing 80·865 kilogrs. of ashes. We have in the same way a unit for every leaf, and, calculating at the same rate, we obtain 28·800 kilogrs. of dried matter or 562·80 grammes of ashes. A coconut tree produces regularly a spathe and a pedunele every month; the common pedunele produces from 10 to 40 nuts; but as many fall off before reaching maturity, the annual crop may be valued at 80. A coconut yields 625 grammes of fibrous envelope, 141 grammes of ligneous shell, 434 grammes of undried kernel, 250 grammes of water. The produce for 25 years, the first seven being unproductive, are as to pedunceles, 63·480 kilogrs. of dried matter, or 4·050 of ashes. The spathes 83·569 kils. of dried matter or 3·353 of ashes. The fibrous envelope, 1,150 kilogs. of ashes, the ligneous shell, 266·310 kilogs. or 3,675 kilogs. of ashes. The kernels 789·500 kilogs. or 8,784 kilogs. of ashes. The water 470 kilogs. or 1196 grammes of ashes. We have prepared two tables: the one shewing the quantity of mineral salts found in the coconut tree in a hundred parts of dried matter at 100 degrees; the other, the quality of mineral salts which a coconut tree draws up from the soil, during a period of 30 years.

On examining the first table, one is struck with the difference of composition which exists among the various parts of the same tree. The salts contained in the kernel and the water are capable of being assimilated, and contributing to our nourishment, the shell which is designed to protect the kernel is formed of pure cellulose matter and contains very little of salt of any kind: the fibrous envelope destined to be the first manure of the young plant, contains a strong proportion of potassic salts: the roots, the stem, and the pedunceles, contain plenty of soluble salts conveyed by the sap which is to nourish the fruit; the leaves, on the contrary, take up but small quantity of soluble salts, for it is the insoluble salts, that predominate here; the leaflets, in particular, are protected at the surface, by a thin layer of silex. By the second table, we see that a coconut tree draws up from the soil in thirty years, 188 kilogrammes* of fixed materials; that the potassic salts form almost the half of those quantities; that marine salt, however indispensable, composes only about the seventh part of the salts that have been discovered; that the phosphate of lime equals almost a fourth part; and that the salts of lime are indispensable. Now the coconut trees which are found on the sea-shore, in a soil saturated with salt water, draw from this ground all the salts

* A kilogramme 2·505 lb. avoirdupois.

necesary for their developement; besides, the animal and vegetable matter which contain salt water, furnish, by their decomposition, a manure abounding in azote and in phosphate. Hence the flourishing condition in which these plants are found in all the coral islands, which have a permeable soil, is easily explained; it is the same with those which are seen on the shore, or which, situated at the mouth of rivers, find there a soil moist, permeable, and in which the water that is constantly renewed also deposits salts, though in smaller quantities than the sea shore. It appears then, that to succeed in the cultivation of the coconut tree in a place remote from the sea, if the plantation is made among sands pertaining to the primitive earths, calcareous manures ought to be conveyed thither; if the cultivated lands be clayey and compact, they should be rendered peameable by a mixture of sand; it is also to be ascertained whether they contain salt of lime; finally if sands of recent formation be cultivated which contain plenty of lime, it would suffice to convey thither potassic salts and animal manure. In all cases, it ought not to be lost sight of that the coconut requires heat, moisture, a permeable soil, salts of lime, alkaline salts, a certain quantity of marine salt, and animal manures. In consequence of these observations, the use of salt, of putrified fish, and of ashes, which are employed in some countries, find its natural explanation. In this way, then by using animal manures, the coconut tree is furnished with azote and phosphates; the ashes supply it with alkaline salts; the calcareous substances in what forms soever they are employed afford lime; the sea weeds and, in default of them sea salt, should be added to the soil; the *cakes* of oil grains, chiefly those of the coconut, furnish an excellent manure. The substance last mentioned, when the oil is expressed, is as it proceeds from native malls of the following composition in 100 parts:—

Water	6·00
Albumine	2·82
Sugar	3·35
Gum	5·30
Oil	14·00
Cellulose	62·15

Ashes.

Chloruret of sodium	0·25
Phosphate of soda, sulphate and carbonate of potash	2·51
Phosphate of lime	2·48
Sulphate and carbonate of lime	0·70
Silex and sand	0·42

Hence it is evident that it offers every substance necessary for the development of the coconut tree, and that it is desirable that it should be employed as manure; it is actually employed to fatten animals. For the proper understanding of what we are about to say, let us remember: 1. That, in all kinds of cultivation it is necessary to restore to the ground what the plant under cultivation has extracted from it; otherwise, it will, after some time, be reduced to barrenness; 2, that plants draw a part of their azoto and of their carbon from the atmosphere; 3, that they derive another portion from the earth, but in the state of solution in water; 4, that even the mineral salt must be dissolved in order to be absorbed; 5, that this solution is promoted by organic manures which, by their decomposition, supply the water with the carbonic acid and the ammoniac salts which augment its dissolving power; 6, that water furnishes plants not only with oxygen and hydrogen, but also serves as a vehicle for the conveyance of all the materials which contribute to their nourishment. Before concluding what concerns the culture of the coconut tree, let us say a few words regarding its chief enemy. It is a coleopterous insect, of which the larva, three inches in length, consumes

a great quantity of vegetable matter; this insect, known by the name of *Oryctes rhinoceros*, gets into the tree by piercing the base of the petiole, it then works its way inside, in the direction of the tree, so as to reach the centre. If it be not removed immediately, or put to death, the tree soon perishes. These insects, which are capable of making great ravages in plantations, make their appearance at intervals of two or three years. For the purpose of destroying them, a piece of pointed iron, jagged on both sides, is introduced into the tree, through the hole which they have made; by this means, they are reached. We have spoken of the wood of the coconut tree, and said that it is of such nature, that it cannot be employed as timber except in instances when the (whole) trunk can be made use of, without the necessity of its being sawn up (into planks); it is even indifferent as fuel. The ashes are very rich in alkaline salts, as they form 63 parts in 100. We have said that leaves serve to cover the roofs of houses, sheds, etc.; and they resist for a considerable time the influences of the atmosphere. The explanation of this we have found in their composition, the ashes contain 83 parts in 100 of insoluble salts, of which 13 parts in 100 are silex. It now remains to review the produce derived from the fruit and sap of the coconut tree, and to say a few words concerning the revenue drawn from this tree. A coconut tree yields, on an average, 80 nuts per year, and may go on producing for 70 to 80 years. - In 1814, four of the Laccadive islands, namely, Ameendavy, Kadamat, Killan, and Chetlat, placed under the protection of England, reckoned a population of 3,609 inhabitants. There were in them 122,000 coconut trees, of which 69,000 were in bearing; the consumption of the fruit by the inhabitants was estimated at the rate of four nuts a day per man. In Malabar the number of these trees is immense: the produce in coconuts is estimated from three to four millions per year, at a value of 1,250,000 francs [£50,000]; copperahs are also exported the value of 1,000,000 francs [£40,000]. In Ceylon the native plantations consists of about 100,000 acres, and those of the Europeans of 20,000; the produce is therefore considerable. The local consumption is estimated at 100 nuts per month for a family of five persons, and besides, the annual exportation is from three to four millions. Here is the sum of the exportation from Ceylon in 1847:

	Francs.
In coconut	137,125
„ coir	257,950
„ copperah	142,575
„ shell and fibrous envelope	5,250
„ oil	478,550
„ arrack	291,425
Total	...1,312,375

In Ceylon, the produce of 100 acres of land planted with coconuts (50 trees per acre) is as follows:—

22,500 gallons of oil	£5,156
Coir	1,031
Poonac, 75 tons at £10	750
Total	£6,937, (173,425 frs.)

In the country of Pondicherry, where about 20,000 hectares* of land are given up to cultivation, a very small part is planted with coconut trees; yet, in spite of this, the Government possess 18,000 trees, and the inhabitants 113,000. On the 1st January, 1860, 8,865 coconut trees were cultivated for their sap: the tax levied for the demesne is 3 rupees per tree yearly, and 2 rupees for six months from the 1st July to the 31st December; this

* A hectare = 2·471 acres.

tax produces, on an average, from 68,000 to 70,000 francs per year. A coconut tree cultivated for *callou* [Toddy] bring to the proprietor a net revenue of 3 francs 60 cents, while the net revenue of the same tree cultivated for nuts, oil or coir, is not valued at more than 1 franc 50 cents. Here is the gross revenue of the coconut trees of Pondicherry, for the year 1857, in coconuts, oil, and toddy. (Annuaire de l'Inde, page 99, 1859): -

		Francs.
1,527,440	Coconuts	45,826
61,332	Litres of oil	27,599
1,383,800	Litres of toddy	207,500
	Total	280,925

At Pondicherry, see how the net produce of a plantation of coconuts is valued; for the *cani* (53 acres, 51 centiares) at 100 trees per *cani*.

Establishment of the plantation, expenses of cultivation during seven years.

	Fr. c.
Interest of capital, imposts	501·00
Gross revenue after 7 years	150·00
Net revenue	92·85

A coconut has, we have said, a fibrous envelope which, on an average, weighs 625 grammes†, the outside presents flexible fibres, which are mixed with a cellular tissue and an incrusting matter. By divers processes, which we shall point out briefly, are obtained fine fibres, of a white or cinnamon hue, or somewhat brown. These differences are owing to the age of the nut or the mode of preparation.

These fibres which bear in Tamoul the name of *Tennam-nar*, are called in Hindustani *coir*,‡ a name which has passed into the English language, and which we have transformed into *Kair*. This product bears a certain commercial importance in 1851. The import trade, to which it has given occasion, was raised, in India, to 231,633 rupees, and the exportation to 281,511 rupees. Its uses among the natives are numerous. Of it are made strings, and coarse nets, but it is chiefly used for making ropes; the native vessels are all provided with them, and many European captains make use of them; in 1851, from Bombay and Ceylon, 10,661 tons of it were exported to England. Buchanan, in his voyage to Mysore and the Malabar coast, remarks that in many places he has seen coconuts cut before arriving at maturity, in order to extract their fibres, since they are of a bad quality when the nuts are ripe. In order to obtain them the husk is soaked in water during nearly six months, after which it is beaten with a club, and the fibres then removed by hand, This process is generally followed, with some modification, in all India and at the Laccadives, where this work is reserved for the women who acquit themselves in it with great skill and address. On some points of the Isle of Ceylon, with the view of avoiding the gaseous emanations, more or less putrid, which exhale from the ditches where the coconut husk is macerated, these husks are buried in moist ground on the borders of salt tanks; after six months, they are dug out, and their fibres are easily removed. A coconut-tree produces from 2 annas to 2½ annas of coir; in Ceylon,

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* A litre=1·76 pints.

† A gramme=15·432 grs. Troy.

‡ The term for *coir*, in Hindustan is *nari-yul-kajhotra*. The Tamil name for string is *kowroo*: and Englishmen, from often hearing this word uttered by natives, have transferred the name of the fibre to raw material. This, I imagine, is the more probable origin of the term *coir*.—*Note by the Translator*.

6 pounds of coir are obtained from 10 nuts; at Mangalore, 5,600 coconuts yield 560 pounds of coir. The actual price of coir at the Laccadives is 13 rupees per candy; at the different markets of the continent of India, it has a medium value of 25 rupees per candy of 640 pounds. Below the fibrous envelope is found a very hard ligneous shell employed in the formation of various utensils; in 1851 a quantity of them was imported into India to the value of 5,970 rupees; the shell supplies a good combustible and an excellent charcoal containing in 100 parts only 1·38 of ashes. The kernel is, confessedly, the most important part of the coconut. This fruit, cropped young, contains within an opaline fluid, which is clear when filtered and used as a beverage. In countries unprovided with drinkable water, nothing but coconut water is drunk; it is a pleasant aliment, wholesome and nutritive. The kernel, which is of a gelatinous consistency, is easily removed with a spoon, and eaten with pleasure; this is a delicate eatable not appreciated enough by Europeans; it contains all the elements of a good nutrition. While ripening, the kernel becomes hard, almost horny, and the oil increases. Although, even at this stage, it is alimentary, it is indigestible of itself, and is not eaten except mixed with other kinds of food. A young coconut weighing 2·150 grammes contains:

Envelope and shell	1·760
Kernel	0·090
Water	0·300

A ripe coconut, weighing 1.500 grains contains:

Fibrous envelope	0·625
Shell	0·141
Kernel	0·434
Water	0·250

Here follows the composition of the alimentary portion of the nut, in 100.

The young nut (water).

Sugar	1·40
Gum	0·47
Phosphate of lime	0·05
Chloruret of sodium	0·09
Acetic acid	0.96
Acetate of lime Do. of potash Sulphate of do.	0·31
Water	97·62

The young nut (kernel).

Sugar	1·00
Gum	0·33
Albumine	1·16
Oil	2·31
Cellulose	4·40
Phosphate of lime	6·01
Chloruret of sodium	0·11
Pectine	0·04
Water	90·34

The ripe nut (water).

Sugar	1·64
Gum	0·26
Phosphate of lime	0·06
Chloruret of sodium	0·10
Acetate of lime and of potash	0·33
Pectic acid	0·08
Albumine	0·16
Water	97·47

The ripe nut (kernel).

Sugar	0·48
Gum	0·71
Albumino	0·30
Oil	30·00
Cellulose	14·41
Colouring matter, salt of potash of soda and of lime	1·10
Water	53·08

According to an analysis of Bizio, the water and the kernel contain no sugars but *mannite*; we believe we must refute this error. The sugar which we have discovered possesses all the chemical properties of sugar produced from the cane; in the water of ripe coconut, one portion is in glucose state. It is seen, by these analyses, that we have reason to consider the young nuts as good nourishment, which is besides proved by the long and exclusive use made of them by the inhabitants of most islands who enjoy by far the most blooming health. Coconuts furnished the means to the three presidencies, in 1851, for an import trade rising to 521,889 rupees; the exports were 10,140 rupees. When the nut is ripe, the fibrous envelope is removed, the nut broken, and the kernel extracted and dried in the sun, and, in this condition, sold by the name of *copra* for the purpose of extracting the oil. The sale of copras is very important: in 1851, it rose in India to 1,296,128 rupees; the Laccadives, Ceylon, and the Malabar Coast are the principal points which furnish this produce. On the Malabar Coast copra is prepared in the following manner: the kernel, divided into two parts, is placed on a frame of bamboos, with intervals, and under it they kindle a fire for two or three days, then the desiccation is completed by exposing the kernels on mats to the sun. The copras, in this state, contain 64·3 parts in 100 of oil. The oil, which is the most important of the produce of the coconut trees, may be prepared in many ways: when it is intended for perfumery, or to be obtained uncoloured, the following process is made use of. The kernel is dipped in water, which has been boiled for some minutes, then withdrawn, scraped, and put into the press; the emulsion thus obtained is set to boil till the soil swims on the surface. Success is attained more easily by scraping the kernel, drying the scraping in a sand-bath and putting it into the press. These processes are not, however, economical enough to warrant their being employed in a factory; mills such as are described by M. Montbrun are made use of. These mills, which cost 250 francs, and last five years, are managed by a man, a boy, and two oxen; by working eight hours per day, 60 kilogrammes of copra are manipulated, from which are extracted 41·20 litres of oil. In Pondicherry 8 fr. 43 cents are paid for the making of one hogshead of oil. Coconut oil holds an important place as an article of exportation. In 1853, the two French ports of Pondicherry and Carikal exported of it to the value of 1,130,643 francs. This oil is colourless, its scent and taste are fabrulous (? *sic*), but characteristic; in contact with sulphuric acid it acquires a grey colour; the best differential characters which may be employed to ascertain its purity are the freezing point and the density; it solidifies at 18 degrees; its density is from 15 degrees to 0·925. At this last temperature, the weight of a hectolitre of oil will be 92·500 kilogrammes; but the works in Pondicherry do not give this temperature. The three following terms may be accepted as a medium, and then the weights are found thus modified: at 25 degrees, the density is 0·9188, weight of a hectolitre will be 91·880 kil; at 30 degrees the density is 0·915, the weight of the hectolitre will be 91·500 kil; at 35 degrees, the density is 0·9116, the weight of the hectolitre will be 91·166 kil. In India, coconut oil is used as a seasoning, for illumination, and in the fabrication of soap. In Europe, numerous uses have been made of it, and in England, the candle manufactories consume a great deal of it. The last product drawn from the coconut-tree is the sap

the *toddy* of the English, *callou* in Tamil. The toddy is cultivated at the Maldives and Laccadives, in Ceylon, on the Coromandel Coast, and on many other points of the continent or the Indian isles. Toddy-drawing is performed at Pondicherry by a class of Indians called *soutiaves*. For the purpose of climbing the trees, they form a cord into a half circle, they pass their feet through it, and embrace the tree with their arms, and mount up very fast by frequent extensions and contractions of the body. They cut off the extremity of the spadix, apply the ligature below the cut, and lightly tap the surface; this operation is renewed for many days successively, until the spadix begins to distil; then they attach to it a little earthen vessel called *panelle*, intended to receive the toddy; every morning and evening the pot is removed, and every day, a very thin slice is cut off the spadix, so as to freshen the wound; the same spadix yields toddy from 30 to 40 days; one of them is developed every month, so that two pots are sometimes seen on the same tree. A coconut tree produces on an average, 288 litres of toddy per year; but during dry years, but half that quantity is obtained. A tree is worked for 12 months, and then left at rest for a year. Toddy has a density which varies from 1·018 to 1·030. Here follows its composition:—

Sugar	1·160
Gum	0·56
Oil	0·04
Albumine	0·12
Chloruret of sodium, acetate and sulphate of potash, phosphate of soda and of lime, silex	0·26
Water	81·42

Toddy is drunk both before and after its fermentation. When it is desired to extract the sugar, the precaution of putting a small quantity of lime into the pots should be used, and yet this means is not sufficient to prevent the fermentation; they put into the pots pieces of charcoal and of the bark of trees containing tannin, particular that of the *Acacia leucophlœa*;† the toddy is then made to evaporate immediately to the consistence of syrup, and poured into coconut shells where it becomes solid; in this state it is known by the name of *jagre*, and consumed by the natives, or delivered into the refining houses where it is transformed into white sugar; when crystallized in small grains it serves for the fabrication of arrack. Toddy is also employed as leaven by bakers in many parts of India; it is added to lime and sand to form mortar. At a medium temperature of 30 degrees the fermentation of toddy last from 18 to 20 hours; when this time is passed, the acetic fermentation begins, and the alcohol is lost. Ten litres of toddy distilled yield 1·58 litre of alcohol at 47 degrees centigrade,‡ or 0·7426 litres of alcohol at 90 degs. centigrade.§

A coconut tree then can yield, in one year, 15·50 litres of alcohol at 47 degs. centigrade, or 20·16 litres at 90 degs. centigrade; if, on the contrary, the toddy is worked to obtain the sugar, 13·148 kil. of sugar may be had from a single tree, for one year, admitting that there is no loss; but as we have observed the, fermentation proceeds very fast, and, in all our analyses, we have found one portion of the sugar transformed into glucose, and consequently, capable of furnishing nothing but molasses to be changed into alcohol. We shall add a few more words to what we have said of the coconut tree. In the season of the dry winds, if the leaflets from the frond of a coconut tree be plucked off, a gummy juice flows out which solidifies into small transparent drops, varying in hue, from pale yellow to reddish brown; this gum swells in water still preserving its shape, it crumbles between the fingers into fragments that do not adhere; the water is coloured of yellow-citron hue, and has the taste of burnt sugar; this solution reddens tournesol paper, its hue is deepened by alkalis, it is coloured ruby red by the addition of sulphate of iron, ruddy violet with ferric sulphate, and deep red in contact

* Portuguese for pot. † In South Ceylon, the natives employ the bark of the *Hal-tree* (Vateria Indica). ‡ Fahrenheit 118. § Fahreheit 194.

with pyrolignite of iron; it reduces the cupropotassique tartrate. The gum is insoluble in alcohol? which turns yellow; boiling water cannot dissolve it; it dissolves in lime water and in a solution of potash; this last solution, neutralised by an acid, is precipitated by alcohol: the precipitate dissolved in water is precipitated by the neutral acetate of lead. When 100 grammes of gum are reduced to ashes, 1·01 grs. of white ashes are obtained, which are composed 0·07 gr. of chloruret of sodium, 0·24 of potassic salts, and 0·67 gr. of lime.

The alcohol at 82 degrees, at which temperature the gum macerated when left to evaporate spontaneously, deposits needle-shaped crystals discolored by a yellow amorphous matter. By macerating the gum in water, evaporating the solution, and collecting the residuum by alcohol, it leaves, on evaporation, a crystalline matter behind; this production may yet again be obtained in treating with aether the water in which the gum had been macerated, or by dissolving the gum in a solution of alkali, neutralising it with an acid, agitating it with the aether. The crystals purified by many crystallizations in water, or rather in alcohol, retain the yellow colouring matter; they are in little cubes or lengthened prisms; heated to 100 degrees, it does not modify itself; put upon a slice of platina heated with a lamp fed by alcohol, they melt, burn without leaving a residuum, and diffuse an odour of burnt sugar; when heated in a tube closed at one of the extremities, it liquifies, volatilizes, and becomes condensed on the sides of the tube, in needle-shaped colourless crystals; these crystals melt on being heated, and sublime again without alternation; on being exposed to the air, they do not change their appearance; they have a somewhat harsh taste, and bring back that of burnt sugar; they are soluble in water, to a small extent, but more soluble in alcohol and æther. The aqueous solution reddens tournesol, restores the activity of Frommherz; it is precipitated white, by the acetate of lead, the azotate of silver, and the bichloruret of mercury; it becomes red by the sulphate of protoxide of iron, and violet by chloruret ferric, and ferric sulphate; the latter mixture is not discoloured by heat, but is discoloured by chloruret of gold.—From this recital it may be concluded that the coconut tree is one most useful tree of the tropical regions. "

JULES LEPINE,
First Class Apothecary to the Navy at Pondicherry.

SOMETHING ABOUT COCONUTS: THE LETTERS OF THE LATE MR. R. DAVIDSON, COCONUT PLANTER JAFFNA.

(From the *Ceylon Observer*, September 17th, 1861.)

M. Lepine's wits must have been wool-gathering when he made his estimate of the produce of coconuts in Ceylon. Here are his dicta:

"In Ceylon the product of 100 acres planted with coconuts (50 feet per acre?) is as following:

M. Lepine's figures.			*Correct figures*		
22,500 gals. of oil	...	£5,156	The true value is	...	£2,343
Coir ...	...	1,031	Coir ...	...	Nil.
Poonac 75 tons at £10..		750	43 tons at £5	...	215
	Total	£6,937	True val. Total	...	£2,558

M. Lepine himself estimates the land under coconuts at 120,000, and Ferguson's Commonplace Book for the present year gives it 123,000 acres which is probably as near the mark as may be: we will take the lower figure and make the calculations on that. In 1859 the exports represented about 40,000,000 nuts. Let us take double that on 80,000,000 for the local consumption and we we will have 120,000,000 as the total produce, or just 1,000 nuts per acre. This would give 100,000 nuts to 1,000 acres, which represents 3,300 gallons of oil at 2s. 1d. per gallon £343 15 0
The corresponding poonac is 124 cwt. at 5s. 31 0 0

Total ... £374 15 0

This is a sad cutting down of an estimate from a gross annual value of £69 11s. 0d. to £3 15s. per acre, but, alas, that I should be forced to say so! It accords much better with the experience of the owners of coconut properly in Ceylon, than M. Lepine's seducing figures, even, when reduced to the true value of the amount of produce indicated. I am aware that the European planters calculate on 5,000 nuts per acre in the future, a future that is pushed forward from year to year, but I fear many of them would have good reason to congratulate themselves, if they realized 2,500 per acre for present crops. It is not, however, coconut planters alone that pick out their finest plants and estimate their future crops by what they yield, as some of our coffee planting brethren could certify if they liked to tell the truth; it takes a great deal of unpleasant experience to convince us that the foundations on which we are building our fortunes are neither firm enough, nor wide enough, to carry the original design.

If M. Lepine has committed errors in his Ceylon estimates, he has not thrown much practical light on his subject, even where he could have no impediment to the acquisition of correct information. He asserts in more than one part of his paper that the annual average produce of the coconut trees of Pondicherry, is 80 nuts. We find in one place the nuts valued at 30 francs per 1,000, and if a tree yields 80 nuts valued at 30 francs per 1,000 the annual gross proceeds of the nuts alone will be 2 francs 40 cents per tree, while he says that the nuts and coir of one tree are not valued at more than 1 franc 50 cents, though this latter sum is the net, not the gross proceeds. It is stated that the gross process of all the products of the coconuts in Pondicherry was in 1857 –280,995 francs, or 2 francs 10 cents per tree, the trees being 131,000; but 8,865 trees reserved for drawing toddy yielded 207,570 francs, which would leave only 73,425 francs for the remaining 122,135 trees, or 60 cents per tree.

It would be perfectly useless to go any further into the figures and statements of M. Lepine. Enough is done to show that they are absurd, contradictory, and unworthy of any confidence whatever. As his analytical labours were within the field of his own profession, it is not improbable that they may be of more value than his other utterances, but the guide who leads us astray in a meadow is not to be trusted in a forest.

Having disposed of M. Lepine's estimates, and calculated the produce of coconuts in Ceylon at 1,000 per acre, I now proceed to show more fully the grounds on which I take the produce at a figure so much lower than any that has ever been given.

In the days when the Sinhalese monarchy possessed its fullest measure of vigour and vitality, the chief seats of population were the most fertile soils. The inhabitants did not then, as now, give their chief attention to the production of articles of foreign commerce; but the provision of the first necessaries of life, for a teeming population, was the first object with kings and chiefs.—Though nature had bestowed on them a soil of inexhaustible fertility, their chief article of produce demanded a supply of water, measured, and regulated in a manner different to that in which nature furnished it. Artificial reservoirs were, therefore, constructed on a vast scale and with immense labour. While the country was blessed with peace and security these stores were multiplied in all directions. All human works are, however, subject to decay, and when foreign invasions and civil discord, called off the attention of Government from their conservation, deterioration must have been rapid, while the skill and energy that originally constructed them departed with equal steps. The breaking of an embankment would reduce a fertile district to sterility; famine would follow with pestilence in its train; all who possessed knowledge or means would retreat to seek new homes; while the uninstructed serfs of the soil left without the skill and the courage on which they had been accustomed to lean for directing their labours would struggle on in idleness and want, till they finally disappeared from the scene, and left the country to nature, and the demon of jungle fever. It was thus that the fertile north became a desert; and thus that the Portuguese found the

Court of the king, and the chief seat of the population near the centre of the least fertile tract in the Island. It had, however, one advantage that suited the condition to which the people had fallen by gradual decline, through a series of ages. Nature supplied it with abundant and seasonable rains, its productions were very numerous, yet few of them required very heavy or long-continued labour to obtain a moderate return. Among these productions the cocoanut became the most important, with the simple exception of paddy. From the sea shore to 20 miles inland, it was found to grow on any land except swamp or still clay; and however poor the natural soil, the presence of a human habitation produced the conditions necessary to abundant fruitfulness; while few spots were so utterly poverty-stricken, as to yield nothing; if the natural growth was now and anon cut from about the plants. Till within the last twenty years, there was no inducement to extend the cultivation of this plant, beyond the supply of local wants. Within that space the exchangeable value of its products nearly quadrupled, and a corresponding interest in extending its cultivation has been manifested. Millions of plants have been *stuck in* by the natives; and Europeans have done as much justice to about 2,000,000 as their skill and means enabled them. It is the misfortune of new beginners in any field of agricultural industry they may strike out for themselves, that they only gain a knowledge of soils fit for their purpose by experience in their own persons. Long before that experience is acquired in the case of cocoanuts, a large amount of capital may be sunk in land that will never return it. I hope that but few of the Ceylon cocoanut planters are in quite so bad a case. It is too probable that three-fourths of the extent they hold will never yield a clear rent of £5 per acre, without the introduction of fertilizing matters from some other sources; but the land must be poor indeed, and the local resources few, where this balance of profits cannot be reached by a moderate expenditure, joined to a sound judgment, and steady perseverance. There is this encouraging peculiarity in plants cultivated for oil, sugar, or starch, that if no other product of the soil be removed, it is never further impoverished: unlike the case of crops that annually remove a certain proportion of its salts and phosphates; so that a cocoanut from which nothing but oil is removed, makes a permanent gain of foreign matter brought into it.

(From the *Ceylon Overland Observer*, 10th October, 1861.)

JAFFNA, 18th September, 1861.

There are some who will not agree with M. JULES LEPINE when he says, in the instructive article you published, "if we knew what are the mineral salts the cocoanut tree draws up from the earth and in what proportions, we should have a precious guide both in the choice of soil and of manure." They consider theory better adapted for Utopia than for Ceylon, and will not even assign to it the position Taylor and others allow to hypothesis. Forgetting that many theories are but truth in embryo, they do not consider it worth their while to "label and shelve" them till experience proves their value. This appears to be a common failing of those engaged in agricultural pursuits, as it wrung from Johnson the bitter complaint "hitherto the appreciation of the discoveries in Agricultural Chemistry have, except by a limited few, been so small—the reception of scientific results and suggestions by the agricultural body generally so ungracious—that little wonder can exist that so many chemists have quitted the field in disgust that the majority of capable men should studiously avoid it."

To such practical men, M. Lepine's researches will be of little interest; but there are many who would like to have the information he gives reduced to English weights and measures. I send you therefore a copy of calculations I have made from the tables you published.

The data on which my calculations are made are these:—

Centimetre ..	= 0·39371 Inches.	Kilogramme ..	= 2·68 Pounds Troy.
Metre ..	= 39·371	Gramme ..	= 15·131 Grs. Troy.

The facts (for such I assume them to be) first enumerated by Lépine, respecting a coconut tree about 30 years old, from 72 to 79 feet high, with a diameter of 9½ to 10 inches, are arranged in table 1, the first column of which shews the weight of all the product of the tree and of the tree itself during its 30 years' growth; *after being dried* at 100° (Centigrade ?)* The second column shews the weight of mineral matter appropriated by each part of the tree during 30 years—and the difference between the two columns shews the amount of organic matter fixed and assimilated during the same period. We have thus:—

	lb. Troy.
Inorganic matter, mineral, salts, ashes	504·07677
Organic matter	9901·61015
Total weight of tree & 30 years' produce after drying at 100°	10,405·71692

TABLE 1.

	Fixed matter after drying at 100°. Pounds Troy.	Mineral Salts, Ashes. Pounds Troy.
Root	21·14 ...	0·6132
Trunk	182·4 ...	41·38992
Leaves	2211·2301 ...	216·71284
Tunics	77·184 ...	1·50616
Peduncles	170·1264 ...	10·8510
Spathes	217·96192 ...	8·98604
Husks	3082· ...	187·3856
Shell	713·7912 ...	9·819
Kernel	2139·980 ...	23·54112
Water	1259·6 ...	3·20528
Total	10405·71692 ...	504·07316

Coconut estates differ apparently from most other descriptions of cultivation inasmuch as that part of the crop (copperah) which is sent to market carries off the estate only a trifling amount of the mineral manures. The copperah from a tree (estimated at 80 nuts per annum—which would satisfy *most proprietors* !) only removes in 23 years† 23·54112 lb. (or a trifle more than 1 lb. annually) of inorganic matter, while the whole of the remaining inorganic (*mineral*) matter is left to be restored to the trees, and the greater part of it just where it is required again—at the foot of the tree.

"—We shall arrive *at an exact knowledge* of the sum of all the ingredients we withdraw from the soil in the different crops.

"With this knowledge *the farmer* will be able to keep an exact record of the produce of his fields in harvest, like the account book of a well-regulated manufactory: and then *by a simple calculation he can determine precisely the substances* he must apply to each field, according to the crops he has reaped, *and the quantity of these restore their fertility*, HE WILL BE ABLE TO EXPRESS, IN POUNDS WEIGHT, how much of this or that element he must give to the soil in order to augment its fertility for any given kind of plants."—*Liebig's Letters on Chemistry.*

September, 27, 1861.

SIR,—Liebig, *anticipating* the time when appropriate manures for plants will be prepared in chemical manufactories, says: A plant will receive only such substances as actually serve it for food; just as at present a few grains of quinine are given to a patient,—instead of the ounce of wood he was formerly compelled to swallow in addition."

In proportion to the assent we accord to this proposition will be the value we attach to M. Lépine's table; the first of which I now send, reduced to its equivalents in English weights. I have taken the liberty of altering the amount of salts of potash, in the spathes, from 0·085 kils. *to* 0·985, as this correction is required to rectify *the two totals. The grand total is* 188·087 instead of 128·087 kils.

* 100° C. = 180° F. † The first seven years are not counted.

No. II.—FIXED MATTER DRAWN UP FROM THE SOIL BY A COCONUT TREE DURING 30 YEARS.

	Root.	Trunk.	Leaves.	Tunics.	Pedun-cles.	Spathes.	Fruit or Drupe.				Total.
							Husk.	Shell.	Kernel.	Water.	
	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy	lb. Troy.
Chloride of Sodium ...	0·04824	7·52544	11·02820	0·04288	1·17116	0·51992	10·47880	0·42880	2·78184	1·10952	35·13480
Salts of Potash ...	0·36180	26·53200	42·56912	0·13936	6·38208	2·63980	138·07360	8·50260	14·55508	1·17936	241·19480
Phosphate of Lime ...	0·05092	1·73664	103·08352	0·20904	1·69912	1·23908	1·84920	0·21140	5·77808	0·61640	116·52640
Salts of Lime ...	0·16348	5·40288	47·47888	0·50116	0·51456	3·24816	34·51840	0·64320	0·12612	...	92·89684
Salts of Magnesia ...	...	...	...	...	0·82008	...	...	...	...	...	0·82008
Silex	0·01876	·19296	12·55312	0·61372	0·06700	1·28908	2·10560	...	...	...	17·20024
Total ...	0·64320	41·38992	216·71284	1·50616	10·85400	8·93604	187·38560	9·84900	23·54112	3·26228	504·07316

In this table, as in the former one, the tree, 30 years old, is supposed to have borne 80 nuts per annum for 23 years. If then we wish to know what description of inorganic matter and how much of it, we must return to the soil, to restore its equilibrium annually, the data are before us. On an estate where the trees are planted 24 feet apart, or 75 to the acre, where the trees yield an average of 80 nuts annually, and only the copperah leaves the estate, the qualities and description of mineral manures given in table on p. xxxiii appear necessary.

If M. Lépine's analysis is correct, and my calculations accurate, before an estate can *continue* to bear thus, either the soil must contain sufficient inorganic matter to bear this annual drain of the several salts, or these must be applied, *at least*, in the quantities mentioned. As the most fertile soil must, in the course of time, fail in all, or at least some of these salts, it would be useful to know whence we can get them, and at what price. It is worth remembering that if any one of the materials essential to the construction of any part of the tree be deficient, that part will not come to perfection and the whole tree will sympathetically suffer. *E. G.* In the second table I find that in 23 years' crop 0·82008 lb. of magnesia is required for the pedunclcs of each tree, or annually per acre 2·67117 lb. I suppose I am right in saying that without magnesia, however little quantity required, no fruit could be matured, no tree thrive. I send you an analysis of bones and of guano which appear to contain the substances required.

OX BONES.

Animal matter	33·30
Phosphate of Lime	57·35
Carbonate of Lime	3·85
Phosphate of Magnesia	2·05
Soda and Common Salt	3·45
	100·00

GUANO.

	Peruvian.	Saldanha Bay.	Bones *(as above).*
Water	13·09	18·35	
Organic matter containing Ammonia	53·17	22·14	
Common Salt and Sulphate of Soda	4·63	5.78	33·30
Carbonate of Lime ...	4·18	1·49	3·45
Phosphates of Lime and Magnesia...	23·54	50·22†	3·85
Silicious matter or sand ...	1·39	2·02	59·40
Total ...	100·00	100·00	100·00

If we now consider the matter, with these tables before us, we find that bones and guano abound in those substances the coconut tree requires; especially in those not common or easily procured. Salt (Chlor. Sod.) is generally cheap where coconut trees grow. Potash can be procured for the cost of burning jungle, and when mixed with the soil its various salts will be formed. Phosphate of lime is not a common substance; and in this, bones and guano abound. The salts of lime would be formed if quicklime were spread over the ground; and silex (sand) can scarcely ever be in too small quantities where the coconut tree grows.

* On the other hand by a judicious application of suitable manure certain parts of plants can be forced or induced to develop themselves.

† Whilst considering only the inorganic manures for coconuts, Saldanha Bay guano appears the more valuable.

It seems that the addition annually of the following matter as manure per acre would suffice, not only to keep "in good heart" a well-bearing estate, but to add to the fertility of the soil.

Salt	25 lb.	(12½ measures.)
Wood Ashes ...	240 lb.	(3 bushels.)
Bones ...	1 bushel (45 lb.)	or guano { Peruvian 100 lb. / Saldanha Bay 50 lb.
Lime	15 lb.	(⅓ bushel.)

With this suggestion I will close for the present, but must give you Liebig's opinion as some justification of my writing first of morganic manures:—

"I have made, during three years, a series of experiments on the action of the mineral ingredients of manures, and have satisfied myself that for perennial plants, such as wood and vines, the ingredients of their ashes, from any source, suffice to render the soil fertile for those plants."

(Supplement to the *Overland Ceylon Observer*, Nov. 16, 1861.)

"Science teaches us what elements are *essential* to every species of plants by an analysis of their ashes."

"The PRINCIPAL *problem for* agriculture is, how to replace those substances which have been taken from the soil, and which cannot be furnished by the atmosphere."—*Liebig's Letters on Chemistry.*

Sept. 30th, 1861.

SIR, In sending you the suggestion for a mixture applicable as a manure to coconut estates, I wrote in round numbers, without minute attention to accuracy. Let us compare the mixture suggested with the ascertained wants of trees as shewn in table V, page xxxiii. (Having no analysis of wood ashes made on the spot, I estimate them to contain 50 per cent. of potash and 10 per cent. of soda. Analysis would probably reduce the amount required to 2 bushels).

The comparison then appears thus:—

TABLE IV.—MIXTURE SUGGESTED COMPARED WITH INORGANIC MATTER REQUIRED.

	Chloride of Sodium.	Soda and its Salts.	Salts of Potash.	Phosphate of Lime.	Lime and its Salts.	Silex.	Salt of Magnesia.	Uncertain, &c.	Total.	
In 25 lb. of Salts ...	19·20	...	2·23	...	0·42	...	3·15	...	25·00	...
„ 240 lb. of Wood-ashes	...	24·00	120·00	...	...	...	...	96·00	240·00	...
„ 45 lb. of Bones ...	...	1·35	...	25·81	1·73	...	0·92	14·99	45·00	...
„ 15 lb. of Lime ...	...	...	...	...	15·00	...	...	...	15·00	...
In mixture suggested	19·20	25·35	122·23	25·81	17·15	...	4·07	110·99	325·00	...
Required	25·01	...	114·70	23·31	15·31	0·53	...	...	181·86	...
Balance favoring soil	...	25·35	7·53	2·50	1·84	...	4·07	110·99	...	152·18
„ against „	8·81	...	...	...	...	0·53	...	...	...	9·34
										143·14

If the 9 lb. of salt deficient in the mixture is not in* or to be formed by atmospheric and other causes from the 26 lb. of "soda and its salts," a little more salt might be added to the mixture. The silex (sand) can never run short.

* Johnson's analysis of bones gives "soda and common salt 2·5 per cent."

I now send you another table, deduced from table II. shewing the total of inorganic and fixed matter drawn up *annually* from an acre by 75 trees bearing 80 nuts per tree:

TABLE V.—TOTAL INORGANIC AND FIXED MATTER DRAWN UP ANNUALLY FROM AN ACRE BY 75 TREES (AT 80 NUTS PER TREE).

	Root.	Trunk.	Leaves.	Tunics	Pedun-cles.	Spathes.	Fruit or Drupe.				Total.
							Husk.	Shell.	Kernel.	Water.	
	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.	lb. Troy.
Chloride of Sodium..	0·12060	18·81360	27·57050	0·10720	3·81900	1·69539	34·17000	1·39826	9·07122	3·61800	100·38377
Salts of Potash ...	0·90150	66·33000	106·42280	0·34840	21·46330	8·60801	450·24000	27·92152	17·16222	1·82400	731·52178
Phosphate of Lime...	0·12730	4·34160	257·70880	0·52260	5·54061	1·20352	6·03000	0·69913	18·84157	2·01000	300·02513
Salts of Lime ...	0·40870	13·50720	118·60720	1·25290	1·67791	10·59183	112·56000	2·09739	1·38952	...	262·18265
Salts of Magnesia ...	...	...	...	...	2·67417	...	...	...	...	...	2·67417
Silex	0·01690	0·48210	31·38280	1·53130	0·21848	1·20352	8·01000	...	...	...	15,90840
Total ...	1·60800	103·47480	541·78210	3·76510	35·39317	29·30230	611·04000	32,11630	76·76453	10·45200	1115·69890

As I do not purpose for the present returning to M. Lépine's tables, a few remarks are necessary.

1. Although I assumed for the purpose of these calculations that they are absolutely correct, I think there is internal evidence that they are not so: *e.g.*, in one table it appears that Magnesia is found only in the flower stalks. In the other table it appears that it exists in 5 other parts of the tree.

2. Admitting this to be the case, they may be as accurate as is necessary for our purpose. They appear to be framed in good faith, else such a palpable discrepancy would not have been accommodated. If only the constituents of the ash are correct, whilst the proportions are wrong, it is much to know of what our trees and their produce are composed- much to know that animal is preferable to vegetable matter as manure.

3. The first two tables, and the fifth are in Pounds Troy, which are less than the weight ordinarily used (Avoirdupois) in the proportion of 55 to 67, so that manures applied by Avoirdupois weight in accordance with the Tables would be somewhat liberally applied.

4. Table V. professes only to shew the amount of inorganic and fixed matter required annually to restore to an acre of well bearing trees the matter abstracted from the soil for certain parts of those trees. The 182 lb. of mineral matter are supplementary to the leaves, spathes, husks, &c., which remain on the estate and are available as manure.

5. Annual application of the matter in table V, or possibly of the mixture I ventured to suggest, might suffice to keep in good heart of a fertile soil *richly* impregnated with the saline matter required; but it is worth considering that whilst any such application can only be a top-dressing, the trees draw what they require from the depth (say) of 15 feet below the surface. It is probable therefore that the result of such manuring would be less perceptible at first than we might imagine. At any rate much would depend upon the care with which it was spread *evenly* over the soil.*

6. Some idea may be formed of the amount of saline matter required for a fertile soil, if we consider that it requires 500 lb. to add 1 grain to every pound of earth, a foot deep in an acre. Yet this is only in the proportion of 1 to 7,000 –it would require 7,500 lb. to add that proportion of saline matter to an acre to the depth of 15 feet.

7. The poorer the soil, the nearer I presume, should the annual application of mineral manure approach the amount in Table V. as this gives the components of all the different parts of trees, which may be supposed to exist already, in fertile soils; or in the droppings from trees growing on them.

8. In M. Lépine's second Table there is mention made of several sulphates, which indicate the bones should, before application, be dissolved in sulphuric acid; but I will not say much of that table as I cannot quite understand it.

"Experiments have actually been abused, as proofs and arguments against the reduction of the *impost on salt*- of all taxes on the continent that which is THE MOST ODIOUS, THE MOST UNNATURAL, AND THE MOST DISGRACEFUL TO HUMAN REASON."– *Liebig's Letter on Chemistry.*

October, 19th 1861.

SIR,—Before leaving the subject of inorganic manures, a few remarks on the salts mentioned may be of use to some, or elicit information from

* At the risk of forestalling future remarks, I must here use as an example the common custom on one point. Nuts are collected from all parts of an estate and husked at the store or other suitable spots. The husks are then left on the spot, or carted to some hollow, or if burnt, the ashe sare applied to the surrounding favoured trees. The tables shew that 643 lb. per acre (*more or less according to produce*) are thus removed (in the husks and shells) from the soil generally and concentrated on one or two favoured spots. Surely we err in doing thus.

others who peruse these letters. I think it may be useful to premise my remarks by stating what cannot be too often repeated That these must be either soluble, or capable of being made so in the process of cultivation, *e.g.*, it is demonstrable that an atom of sulphur cannot weigh more than

$$\frac{1}{2{,}015{,}000{,}000{,}000}\text{th}$$

part of a grain, yet roots would not absorb it unless dissolved in a liquid. Reduce charcoal to the most impalpable powder; and roots will refuse to absorb it; but induce it to combine with oxyzen, it is then readily dissolved, and in this state roots greedily absorb it.

CHLORIDE OF SODIUM. We all know the nature and some of the properties of common salt. Most of us know that it is essential to the existence of man and of animals; but few know that it is as essential to the growth of vegetables. It is found in all organized bodies, whether animal or vegetable; and acts otherwise than as a mere ingredient of these bodies. Were I to say that it acts as a *stimulant*, I might state what I could not explain; but I could point to its operation in the animal economy, as proof of its possessing properties essentially differing from those of any other "*Salts*;" properties, adapting it peculiarly to a tree, in which the ever-circulating sap is perpetually varying in constitution and density. Such being the case, we can understand why the coconut tree thrives best where it feels the influence of spray, borne on the wings of the wind. A tree requires annually 1·34 lb. of salt and 9·79 lb. of potash; yet on the above supposition the latter, and larger amount, may be less essential to its welfare than the former and smaller quantity; because this possesses properties which the other has not, and for the want of which nothing else will compensate. If I am right in this matter, the weight of salt required, (compared with the other inorganic matter), does not exhibit fairly its relative value as a manure. Theory is, here, *apparently* at variance with experience; but only so because a property belongs to salt, of which chemical analysis takes no cognizance. It shews the elements and proportions of them, in any object; but does not exhibit all the properties of them. Most of those who have carefully considered M. Lépine's tables were probably as much surprised as he appears to have been at finding how small a proportion salt bears to the whole inorganic matter in a tree; because observation and experience lead one to anticipate a much larger amount. This is precisely one of those cases in which the man who undervalues theory has the advantage. He can point to experience and say that whether science in general, and chemical analysis in particular, be for or against him. Salt is THE manure which he *must* have. The late Dr. Gardner used to describe the value attached, in the Brazils, to salt as a manure for Coconuts; stating that a man would walk many miles for it, pay high for a load, and then apply it to a single tree. At Singapore the ashes of a plant, rich in salt, are used with extraordinary results; and I think that at Batticaloa the ashes of the mandrake are from the same cause, those which produce the most effect. Here, day after day, may be seen strings of carts, creeping from the beach to the estates, laden with sea-weed; which experience has proved so useful as a manure. For the sake of the salt it contains (22·25 per cent. in the ash,) we drive a cart load of matter which we could obtain (if required) much nearer, and at a tithe of the cost, because our rulers persistently refuse to allow us *at the price they sell it for exportation*, to purchase that salt for our estates, which it sometimes *costs hundreds of pounds* TO DESTROY. I know not what has been done elsewhere in the hope of getting it for agricultural purposes, at a reduced rate; but it may be useful to show that the planters of the Northern Province have done their utmost. I think I am right, (I write from memory) in saying that the following offer was made to Government. Parties, to get salt at export price, would adulterate it, with tar water or any other matter best adapted to render it unfit for culinary purposes, in the Government store. Before removing it they would enter into a penalty bond, to the full value of the salt, at the market price, that it should be used solely as manure for

coconut trees, and they would pay for a Government employee who should certify to its application as specified. This offer, like every other, was refused. About a month ago a petition for salt at reduced rates was refused on the ground that it given at reduced rates for agricultural purposes, it must be given at the same rate to fish curers, &c. The fallacy of this reasoning is apparent if we consider that it places the producer and manufacturer in the same category; and applies to them in common a principle acting differently on each. We deserve, perhaps, that our wants should be disregarded; for I do not remember that coconut planters have ever combined to have them fairly represented. With more of unity and combination in our efforts we should doubtless command success.

SALTS OF SODA, POTASH, AND LIME.—Potash is the principal ingredient of the ashes of land plants; Soda of marine plants. Lime results from burning limestone or coral. These three are compounds of insoluble metals and the oxygen of the atmosphere, the combination being soluble in water. The salts mentioned are (with the exception of the sulphates and chlorides) varied combinations of these metals with different constituents of the atmosphere; and under varied circumstances are *by atmospheric agency*, interchangeable the one into the other. Compounds of soda into other soda salts, &c. It follows therefore, that though we apply only potash to a tree, it may soon under favourable circumstances be converted by the atmosphere, into a nitrate or carbonate of potash: and so with the others. *Salt alone is necessary* because we cannot elsewhere procure the chlorine to convert soda into salts. Our work seems thus to be, to apply the potash, soda, lime, &c., in such a state as we can procure them cheapest; and to cultivate so as to expose them, under the most favourable conditions to atmospheric agency.

CARBONATE OF LIME which plays such an important part in the economy of nature may be perhaps taken as a type of these changes, &c., in the properties of salts, by an alteration of their constituents. If pure water is poured on newly burnt lime, 700 parts of water dissolve 1 of lime. Blow through a tube into this liquid, and the carbonate acid of the breath combines with the lime to form carbonate of lime; (chalk) which being insoluble in water, falls in white flakes to the bottom. Continue to blow, and this white powder will be converted into the bicarbonate of lime; which, being soluble in 1,500 parts of water, is redissolved. Now apply heat and one part of carbonic acid being dispelled, the insoluble carbonate of lime is again formed, and falls to the bottom as before. Precisely such an operation is naturally carried on wherever water impregnated with carbonic acid meets with lime. We see this process going on in Jaffna, where the coral (containing 95 per cent of carbonate of lime) is being converted into limestone. In limestone regions, caverns exhibit from their roofs, stalactites (crystals of carbonate of lime), formed by the evaporation of water which has dissolved carbonate of lime whilst trickling through crevices in the superincumbent limestone. Fossils are often met with, in which, whilst the shell is not visible, the space once occupied by the animals is filled with crystals; here, water containing carbonic acid has dissolved the carbonate of lime in the shell: and deposited it, when evaporating, in the hollow where the animal once was. Carbonate of lime is deposited from its solutions, in forms varying with the temperature at which, and the rapidity with which, evaporation occurs. A smooth *soapy*, unctuous feeling when touched, indicates the presence of Magnesia in limestone. I have dwelt on this subject because it affords a common illustration of the action of carbonic acid, and should be remembered in deciding what to do with rubbish on an estate.

Allow me space for one more common illustration of the changes occurring in nature. We build a stable or cow-shed and plaster it with mortar; which as it hardens absorbs carbonic acid to form the hard carbonate of lime. (On polished mortar you can see the water, as "*sweat*"

which has given place to the carbonic acid.) When ammonia from putrefying animal matter is allowed to mix with damp air, nitric acid is the result which, combining with the lime, forms the nitrate of lime; which, being deliquescent, keeps the wall contently moist, and effloresces on the walls. The "whitewash peels off." These two illustrations may exhibit the operations carried on imperceptibly through natural atmospheric agency.

PHOSPHATE OF LIME.—This salt which, after Potash, is found in the largest quantities in the ash of the Cocoanut tree is commonly known as "bone earth." It is insoluble in water; but dissolves readily in any acid, such as carbonic acid; and even in acetic acid. As an illustration of the solvent powers of rain water (which always contains carbonic acid in solution) Liebig mentions that an animal buried on the slope of a hill, was examined after some years: when not a trace of bone earth was discovered. When a cemetery in Paris was removed, the fat (adipocere) was sold to be converted into soap and candles;* but the *bones had disappeared.*

SILEX.—Perhaps the ordinary burning of leaves, &c., would render the sand sufficiently soluble as a sort of soluble glass results from burning potash with silica.

MAGNESIA.—Though the quantity required is so small, yet it deserves consideration. Probably bones, ashes of all kinds, and vegetable and animal manures contain as much as is required.

(From the *Overland Ceylon Observer*, Nov. 29th, 1861.)

Great as is the importance of paying due attention to the inorganic parts of a tree, equal, if not greater, importance attaches to the organic. it would be useless to place before an animal a profusion of luxuries, as long as its state of health prevented its deriving benefit from them: and, I suppose, equally useless to apply manures to a plant, without a corresponding attention to the organs provided to assimilate and fix them.

Chemistry teaches that all organic matter is composed of atmospheric elements, variously combined in certain definite and unvarying proportions.† Careful investigations has proved that plants inhale one portion of their elements, *directly* from the atmosphere by their leaves; and absorb the remainder indirectly from the atmosphere; through water and matter it contains in solution, and decomposing organic matter in the soil bytheir roots.

If we compare the elements of the organic parts of plants with those of the atmosphere, they appear thus:—

Elements of Organic matter.		*Elements of the Atmosphere*		
Nitrogen		Nitrogen 77 per cent.		
Oxygen		Oxygen 23		
		100		
Carbon...	Carbonic Acid	Carbon	Oxygen	about $\frac{1}{2000}$
Hydrogen	Water as vapour	Oxygen	Hydrogen	A variable quantity.

We thus find that there are in the atmosphere all the elements of which organic matter is composed.

For the sake of convenience, Chemists use symbols (generally the first letters of their names) to denote the elements. Suppose that T. represents a certain defined quantity of tea, M. of milk, S. of sugar; then T. M. S. might stand for a cup of tea, 2 T. M. S. for two cups of tea, T. M. for

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* To what base uses may we come at last

† Sulphur is found in some but need hardly be noticed here.

a cup of tea without sugar, and so on. The principle is widely applicable. The symbols may represent a defined weight or bulk. Chemists employ them to denote a *relative* weight. Unable to find the *absolute* weight of an elementary atom, they use the symbol to denote that weight of any element, which combines in any constant, defined proportion with other elements. Thus H. O. represents water. Whatever the weight of water, 8 parts will be oxygen and 1 part hydrogen; because hydrogen and oxygen combined in those proportions, are water.

Understanding this, I may, perhaps, use symbols to shew the composition of those organic parts of the tree, mentioned in Mr. Lépine's article. The following table, though it looks hard to understand, will be useful when I trace the conversion of one organic substance into another, and speak of the action of manures,

Let C stand for carbon, H for hydrogen, O for oxygen, S for sulphur HO for water, then :—

Acetic Acid is composed of	C4, H3, O3.
Sugar (Cane) „	C12, H9, O9, 2HO.
Starch „	C12, H10, O10.
Cellulose (Lignium or Woody Fibre) composed of	C12, H10, O10.
Gum ... ... „	C12, H11, O11.
Sugar (Grape) ... ... „	C12, H12, O12, 2HO.
Oil ... . „	
Corinic Acid ... ... „	C26, H25, O3, HO.
Pectin ... . „	C32, H24, O32.
Pectic Acid ... . „	C32, H20, O28, 2HO.
Albumen ... ... „	C216, H169, O68, N27, S2.

A few remarks seem requisite :

1. Though chemists differ as to the exact proportions in which the elements are combined in the first six substances, yet all agree that they are all composed of carbon, and water or its elements, in the proportions in which they constitute water.

2. However similar the elements of organic matter and of the atmosphere, vegetables cannot absorb the latter, under any circumstances, in a simple state, *e.g.* Though surrounded by the nitrogen of the atmosphere, they cannot inhale it; but decompose ammonia and nitric acid, and fix the nitrogen at the moment of separation.

3. Though apparently so different, all vegetable organic matter is so nearly indentical in comparison, that but slight attention is required to convert one into another.

4. As we found was the case with the carbonate of lime, so we now find that organic substances different in appearance and properties, may be composed of precisely the same matter, in the same proportions. The difference is only one of structure.

ACETIC ACID.—All vegetable juices, capable of undergoing fermentation to form spirits, can be converted into acetic acid—*vinegar*. Our coconut water, therefore, might be thus used. Probably it would, if allowed to trickle over wood shavings, be converted into vinegar in a day. I would suggest its use together with lime the acetate of lime being so soluble and fertilizing, as well as being found in the nut.

SUGAR. Is almost identical with the former; strike off the two parts of water of crystallization, and three proportions of acetate acid remain. From investigation into the malting process, the growth of cane, &c., it would appear that sugar is starch, in process of information into cellulose (or woody fibre.)

STARCH.—Is apparently the nutrition of vegetables stored up where required most:

1. In seeds, to supply concentrated food to the plant when germinating.

2. In bulbs and tubers do do

3.—In endogens, (sago palm for instance,) to sustain the growth of the leaves during dry weather.

It is proved that starch is formed from sugar, by the disappearance of the latter as a plant matures its seeds.

CELLULOSE. Probably the proportion of carbon in cellulose determines the quality of any wood.

Iron wood is said to contain	53·44	per cent. of carbon.			
Oak	,,	,,	52·53	,,	,,
Willow	,,	,,	49·80	,,	,,

The variety of colour and grain in different woods causes the differences observable in them. The base of all woody matter (cellulose) is almost identical. Foreign matters cause the difference.

GRAPE SUGAR. Is the state in which sugar generally exists in fruits.

GUM.—Is probably liquid starch; and serves in a *free* condition the same purpose as starch does in a *fixed* state.

OIL.—Differs from the preceding in its want of oxygen, thus fitting the hydrogen for combustion in oxygen; whilst the carbon is present to make the burning hydrogen luminous.

PECTIN AND PECTIC ACID differ from all the previous substances, in having a larger proportion of oxygen. Pectin gives its consistency to fruit-jelly. Pectic acid is found in turnips, carrots, &c., in apples, plums, &c. It seems to serve the purpose of giving consistency to fruits, &c.

ALBUMEN. This the only substance M. Lépine mentions which contains nitrogen. It contains also a trace of phosphorus. It is found in the juices of all nutritious vegetables.

I have stated before that the elements of organic vegetable matter are derived from the atmosphere, directly by leaves and indirectly through the soil by its roots.

1. As we have no control over the atmosphere from which leaves derive nourishment, should we do not be more careful in the exercise of the control we have over the leaves?

2. We have, if we employ it aright, perfect control over that portion of the nourishment of trees, which is derived through the soil, by the roots; and we can exercise this control by a judicious cultivation, under which term I would embrace such operations as manuring, ploughing, &c., &c.

You will not perhaps disagree with me when I call soil, the stomach of plants; if you consider well the resemblance there is in the organs of animals and vegetables, and the analogy that exists between their functions. Man sends down his throat fish, flesh and fowl; animal, vegetable and mineral; solid and liquid matters; Part of which by the aid of gastric juice, is converted into a homogeneous milky fluid, which after admixture of bile, air, &c., supplies to the appropriate glands, &c., the secretions and excretions it is their business to form. In the same way we put into the soil animal, vegetable and mineral manures. Carbonic acid acts the part of gastric juice, and the gases inhaled by the leaves, that of bile, &c. In circulating, the liquid formed meets with glands, prepared to take up the various secretions; and finally, what is not required is excreted. In either case, we supply the crude nourishment; the animal's or vegetable's stomach digests and assimilates the matter; thus, in the one case blood, and in the other case sap, is formed.

(From the *Overland Ceylon Observer*, Dec. 17th, 1861.)

December 17th, 1861.

SIR,—Having at the close of my last letter noticed the food of plants until it was fit for absorption and circulation, let us first follow its course and then notice the organs connected with it. Water, holding in solution carbonic acid and soluble salts mentioned, is absorbed by the roots, and may now be called sap; which, as it ascends is constantly varying in density and constitution, as it dissolves in its course gum and other such substances, deposited as we shall see hereafter.* The sap ascends and is conveyed to the upper side of the leaves, and then passed to the under side, whence it is returned to the trunk. It is now no longer what it previously was: for, in the leaf, water has been evaporated; and consequently much of the earthy salts have been deposited. Carbonic acid has been inhaled by the leaf, the carbon retained and added to the sap, while oxygen has been exhaled. Ammonia too and other gaseous matters have been inhaled to alter the sap. Indeed, after a little consideration, it is hardly extraordinary to hear that the peasants of Teneriffe suck the sap of a highly poisonous plant *(Euphorbia Canariensis)* by passing a tube through the descending poison. The inspissated sap is, as I said, returned to the trunk. Here I am somewhat at fault. I am not aware that the study of vegetable physiology has been so far prosecuted in the tropics, as to lead to a decision in what vessels the ascending and descending sap circulates in *Endogens* (palms, &c.); but imagine that I cannot go far wrong, if, reasoning by analogy from *Exogens* (trees with bark), I conclude that the descending sap deposits starch and gum where there are organs to take them up, and where they are again dissolved by the ascending sap, as before mentioned. If anything not required by the tree has been taken up in the sap it is returned to the roots and excreted by them.

I think I must have tried your patience whilst generalizing as I have done, but hope that these preliminary remarks may serve somewhat in the same way as a definition of terms does in argumentation, and prepare the way for more practical letters. Let us then notice in detail the most important parts of a tree.

Roots have a two-fold duty to perform—to afford mechanical support to the tree, and to forage for food in the soil. The former is by no means an unimportant matter well worthy of consideration when planting on mounds, and when digging round a tree, either for the purpose of burying manure, or of pruning the roots; for, if we consider the force with which wind acts on the leaves of a tree, and remember that it does so with lever power in proportion to the height of a tree, we shall be surprised, that in a storm so few trees are uprooted; especially as the accompanying rain softens the ground, and affords less *hold* to the roots.

Whatever the size or shape or roots, they have all more or less thread-like rootlets, each of which terminates is a soft sponge-like substance, termed from its nature a *spongiole*. It is almost entirely by these spongioles that the plant draws nourishment from the soil. Though the roolets are bundles of minute tubes, the spogioles are not simply the open mouths of these tubes, into which water may flow; but spongy buds, with hygrometric properties, to attract any moisture in their vicinity. Being only adapted to absorb water, they cannot take up any solid matter, however, minutely levigated, or inhale gaseous matter. If I am right in the last particular, it appears to be a popular error to say that any cultivation is conducted with a view to admit *air* to the roots; for any such process can only be useful in as far as it admits moisture to them, whether or not that moisture has air in solution. Roots lengthen by the constant

* If a birch tree is tapped in spring near the ground, a whitish limpid fluid flows out: at a height of five or six feet the fluid which flows on tapping, is astringent.

formation of new spongioles, as the old ones become woody; not by general increase of the body of the root, so as to push forward the same spongiole. They can form fresh rootlets and spongioles from the numerous buds on their surface, if an insuperable obstacle obstructs the progress of a root, or if, by cutting or otherwise, the extremity of a root is destroyed. They can also send out rootlets *in search* of distant food, as it is observable in mountainous regions, where they are often seen traversing the bare face of a rock, to reach appropriate food beyond it.

There are three subjects respecting which I would solicit information:—(1) Suppose I wish to apply ashes as a top-dressing, where should I place them? Of course, the object would be to place where the roots could most readily obtain the benefit of them. Some place them just at the foot of a tree—natives invariably do so. Others place them in circles at various distances round trees. I presume that one object would be to place them where there would be most moisture. If so it is worth noticing that the leaves of trees are so arranged, as to throw off moisture to some distance from the trunk. Dewdrops always fall away from the trunk, as the pointed ends of the leaves are best adapted to condense dew. It is true that, in a shower, some rain does always run down the trunk of a coconut tree, but by far the larger proportion is thrown away from it. Perhaps nature, ever true in her analogies, thus indicates where the greatest number of spongioles are to be met with,—and, if so, top-dressing should be performed at a distance from the tree.

2. As the roots of a coconut tree radiate sideways and downwards, some of them must in the course of time reach the *line of perpetual water*. It may seem perhaps puerile to those who have seen the roots striking into the sand and ooze of rivers and backwaters, if I ask, do these roots continue to grow beyond the line of perpetual water? Near the bank of a river the constantly shifting bed may bury more or less nourishment for the roots to find; and the flowing tide may act more or less in the same way,—but, *inland*, will roots strike down into the soil below the line of perpetual water? This is a question of some importance to those with much low land, for the solution would bear upon the question of drainage. I suppose that roots do not push forward for any "blind necessity" to follow that direction. If any would subject to the expression that they *select* the course they will pursue, he could not object to my saying that they are *induced* to follow a certain course, by nourishment to be found in pursuing it. Where then is the inducement to strike below the low water level? As percolation through soil appears to deprive water of matters it holds in solution, we find less of soluble matter in the soil the deeper we dig. As water cannot be said to percolate below the level mentioned, it cannot attract after it the air which serves to decompose soil to form potash, &c., and, admitting that water there contains carbonic acid, it can hardly be in an active state. If to such considerations we add that, when water stagnates, combinations injurious to vegetation are formed, from both organic and inorganic matter, it would appear reasonable to conclude that roots do not strike below the level of perpetual water.

3. Have roots the power of *selecting* their food, or do they take up, promiscuously, all soluble matter within their reach? On this subject testimony is so conflicting that perhaps there is equally good authority for either side of the question. Yet it is a question worth deciding, as on it depends the way in which manures should be applied—for a third of a bushel of lime applied annually, might be very beneficial; whereas a bushel applied once in three years might be injurious.

TRUNK.—One great difference exists between the coconut tree and such trees as the mango; for, whereas in the latter, there is bark surrounding the wood, in the former there is none. Indeed, the whole trunk of the coconut tree appears to be tolerably well adapted for carrying on all the functions of life. On one hand—you see fruit-

bearing trees of which, for some feet high, almost the entire trunk has been destroyed: so as to leave a mere *shell*, barely sufficient to support the tree; on the other hand, the outside of the tree is destroyed so as to leave merely a central column: from which it would appear, that all parts of the trunk indiscriminately are capable of discharging all the necessary functions of life. Coconut planters are thus (perhaps) deprived of the means of employing one operation successfully pursued in arboriculture, that of *forcing* fruit trees to bear, by "ringing" the bark.* May we not on some such principle account for the measure of success attending the rude plans of driving a large nail into a tree that will not bear, or cutting a hole through the trunk, "till you can see day-light through"? Probably cutting a hole through the trunk, to a certain extent, answers to the two operations of "ringing" the bark, and of pruning the roots; for if the ascending and descending sap vessels are intermixed in the trunk, cutting a hole in it must sever both sets of vessels. Now the two operations are conducted with different objects in view—pruning the roots with the view of regulating the flow of ascending sap, "ringing" the bark with the view of arresting the flow of descending sap; they should therefore be practised at different seasons.

But I am digressing, Though they have not been discovered there are doubtless in the trunk, organs corresponding to the glands of animals, by means of which the tree elaborates from the inspissated sap the various substances, sugar, gum, starch, woody fibre, &c., each of which *as required* is separated *where needed*.

LEAVES.—It is impossible to overrate the importance of the leaves; for not only are they the lungs of the tree, but they also perform the office of a heart, in causing the circulation of the sap; for it is the alteration in the density and constitution of the sap which† gives rise to the ascent and descent of it.‡

By the leaves water is evaporated, consequently a large proportion of the less soluble earthy salts is deposited, and consequently all leaves yield more of them by weight than any other part of a tree. By day, leaves inhale carbonic acid, retain the carbon and emit the oxygen§; by night, they reverse the process, and inhale oxygen, exhaling (though in small quantities) carbonic acid. They also inhale ammonia and other gases. We thus find that not only the sap contains originally, but the leaves also inhale all those elements which, variously combined in definite proportions, from the organic parts of a tree. If we now refer to the table shewing the composition of the organic parts of a tree, and allow to the organs of the tree the power of selecting and assimilating such portions of the sap as they respectively require, we shall hardly be surprised to find such a variety of substances formed from one liquid.

I think we do not sufficiently appreciate the importance of the leaves. We allow cattle to graze where supplies are planted; with what results you can imagine, if you remember that, in our dry weather, the cocoanut leaves are the only green thing the cattle see. If fences are made round the supplies they are often such as to shade them too much from the sun,‖ and to prevent circulation of air. As plants grow up, leaves are cut off, or irreparably injured by the ploughmen, in order to allow of the plough working close to the plants. About the time the tree comes into bearing,

* Have upcountry planters tried this?

† By endosmose and exosmose.

‡ In a vine growing to the height of 20 feet, it was found that the sap near the roots flowed with force equal to five times that of the blood in the crural veins of a horse.

§ Leaves decompose carbonic acid only in the sun's rays, not in diffused light.

‖ A sunflower three feet high evaporates 20 ounces daily, and a tract of forest evaporates more water than an equal extent of water.

the leaves are of a nice size for making cadjans, with which our roofs are covered, and it is not perhaps exaggeration to say that 30 cadjans per acre are annually required on an estate which has buildings. There are doubtless good arguments to support the practice of pulling off trees every dry leaf that will come away, but unquestionably the result is, that the loss of the mechanical support afforded by the dried leaves, causes healthy leaves to wither and die. Other benefits may more than counterbalance any injury sustained by this practice, but in this one-sided view it appears injurious.

FLOWERS, &c.– The "chief end" of all vegetables is to mature their seeds; to that end all their energies are directed. One of those simple arrangements which so frequently challenge the admiration of the student of nature deserves notice. Flower-stalks occupy an intermediate position between two leaves so that the benefit of the ascending and descending sap, from either of which they can select what they require. Morphology seems to indicate that flowers and fruits are but modifications of leaves; and that the latter can be converted into the former, in the early stages of their existence, by regulating the flow of sap. Precocious fertility is an indication of disease in a tree, and nothing is more common than to see a tree with an extraordinary quantity of fruit, just as it is about to die. It is the last effort of nature for the perpetuation of the species.

In my next letter I purpose entering on the *cultivation* of coconuts.

(From the *Overland Ceylon Observer*, 31st Dec., 1861.)

I have read with great gusto the practical information thrown out by your correspondent "Delta", and his figures and calculations show a degree of no ordinary industry and research into the chemical ingredients adapted to the coconut tree.

The first grand leading idea of every planter must be, the cheapest, the best, and the most plentiful means of supplying manure composed of those ingredients for improving *all the parts of a coconut tree*, for increasing the trunk or barrel in size and as it were protuberance, for increasing the tops of the tree in thickness of foliage and branches for imparting a more healthy hue to the leaves, and for swelling out the husk and increasing the number on the trees, and for making the kernel more valuable in size and weight. On these, Sir, hinge the whole mystery of coconut planting as resulting from a practical mind.

An article of mine on the same subject graced the columns of your *first* "commonplace book," and I see no reason since to alter that article in *one* iota, but as years roll by and experience becomes more and more matured and refined, *dead* indeed must that soul and intellect be which cannot travel with, and keep up to the progress of the age.

"Delta" has framed some nicely calculated tables which could not be made use of generally by capitalists without first having proofs positive of their success, there must be no haphazard work, for Liebig states that in order to know the the value of any guano it is not sufficent to ascertain the quantity of nirogen and phosphoric acid in it, but also the amount of oxalic acid.

Here then we have a warning from the great amount of scientific knowledge possessed by Liebig, Suppose we commence with manure which would cost from £8 to £10 per ton, which would produce 80 to 100 nuts from each tree anually and calculating say 70 trees to the acre we have, at the rate of £2 10s. per 1,000, the value of an acre of land about £14.

The expenses of cultivation and mangement have to come out of that, which at high manuring would leave little or no profits to the capitalist. Eighty nuts to the tree annually, given by "Delta," is entirely a misconception, as none but the very best soil would produce that number without manuring.

Seeing the difficulty of producing manure as suggested by "Delta," why not look into the books of our own leading practical agriculturists who lay down as a principle that we ought to return to the land as much as possible of the nature of the products we remove from it; and this leads to the question, do coconut trees give us any ingredients in themselves which would make highly fertilizing manure? Most certainly. The poonac and water of the kernel mixed with bullock dung, weeds, &c., creates the best and most fertilizing manure I have yet seen, except the compost manure made at the Hulftsdorp Mills by Mr. D. Wilson who has done more than any other man in Ceylon for its agricultural interests, whether we speak of coffee or coconut estates where that rich and prolific *manure* has been used.

The husk, if used aright around the trunks of the trees, affords a most valuable manure, and its effects are to be reckoned in more respects than one in a climate like Ceylon, where there are from three to four months of the year of the most intense drought and heat. It stands to reason, therefore, that any substance which will keep the roots of the trees *moist and cool*, and which will deaden the effects of the sun, must be most valuable. I can show trees, with from 60 to 80 nuts, each possessing the most luxuriant foliage, and which the drought can never injure and put back, and which last year stood up against one of the driest years known in Ceylon. Tying a pair of bullocks to a tree for ten nights will beat out anything "Delta" can fancy, and most certainly he gives far *too* small quantity of manure to a tree.

I have read with great interest Mr. Mead's lecture on the products of Ceylon, and as a practical man residing in the district adjoining where he carried on his operations, I totally and entirely dissent from his views which I believe to be most erroneous. Where industry, prudence, foresight and energy are brought into play, failure is impossible; and I consider Ceylon one of the most splendid agricultural countries of the world when right principles are acted upon, and I trust that capitalists will not be gulled by all Mr. Mead said even though anxiously listened to by a highly influential audience.

Yours,

PUBLICOLA.

P.S.—I enclose two practical tabular statements as resulting from experience which I prize more than all the theoritical inexperienced *data* to be found.

No. 1—TABULAR STATEMENT OF GENERAL YIELD OF COCONUTS PER TREE ON THE AVERAGE OF THE VARIOUS SOILS.

Names of Soils.	Average yield per tree annually.	Value per acre at the rate of 70 trees to the acre and at £2 10s per 1,000. £. s. d.	Remarks.
1.—White poor sandy soil	15	2 10 0	In all these averages, the trees are supposed to have reached from 14 to 20 years old, as the bearing of a coconut tree is very irregular until it attains its full bearing condition, except by manuring.
2.—Dark mouldy ...	30	5 0 0	
3.—Reddish	40	7 0 0	
4.—Strong rich upland soil bordering the banks of a river...	50	8 15 0	

N.B.—The nuts in the two tables are computed at £2 10. 0d. per 1,000.

No. 2.—TABULAR STATEMENT OF THE MANURES, QUANTITIES, COST, AND ANNUAL VALUE OF EACH IN THE ORDER OF No. 1 TABLE.

SPECIES OF MANURE.	Quantity per tree.	Cost per tree—including transport.	Annual average per tree.	Annual value of No. 1 soil per acre of 70 trees.	Quantity per tree.	Cost per tree including—transport.	Annual average per tree.	Annual value of No. 2 soil per acre of 70 trees.	Quantity per tree.	Cost per tree—including transport.	Annual average per tree.	Annual value of No. 3 soil per acre of 70 trees.	Quantity per tree.	Cost per tree—including transport.	Annual average per tree.	Annual value of No. 4 soil per acre of 70 trees.	REMARKS.		
	lb.	s. d.			lb.	s. d.			lb.	s. d.			lb.	s. d.					
Hulftsdorp Mills Compost ...	112	1 0	60	10 10 0	75	3 0	75	13 2 6	60	2 1	80	14 0 0	56	2 0	100	17 10 0	Lasting properties 5 years.		
Poonac mixed with Bullock manure, mud, &c. ...	336	1 6	40	7 0 0	200	1 0	50	8 15 0	168	0 8	55	9 12 6	150	0 7	60	10 10 0	Do	do	3 „
Tying a pair of Bullocks for ten nights to a tree ...	50	0 4½	40	7 0 0	50	0 4½	50	8 51 0	50	0 4½	55	9 12 6	50	0 4½	60	10 10 0	Do	do	3 „
One cart load of husks ...	560	0 4½	40	7 0 0	560	0 4½	50	8 15 0	560	0 4½	55	9 12 6	560	0 4½	60	10 10 0	Do	do	7 to 8 „

The cost of cultivation, for Superintendence, labour, watching, &c., and all other incidental expenses ought not to exceed more than from £1 to £1 5s. per acre annually, where labour is from 6d. to 7d. per diem; where labour is 3½d. to 3¾d. per diem, only the half of the above. These calculations are for low sandy ground, but cultivation on strong upland soil will cost more.

(From the *Overland Ceylon Observer*, 3rd March 1862.)

JAFFNA, 31st Jan., 1862.

I must apologize for my long silence by stating that I have been busy counting nuts on the trees; a practice generally employed here, with the view of framing an estimate of the crop for the current year. As this is a custom which may not be universal throughout the Island, allow me to describe the *modus operandi*. A. in January, counts every nut, however small, he can see on the trees. B counts only those as large as a duck's egg. C. does not count till March. D. strikes off from the number counted 25 per cent. E. strikes off the odd thousands after hundreds of thousands. Each prefers his own method of counting, and each somehow comes nearer the mark. Each expects to get the number counted, whether a dry season brings on, or a wet one retards the maturing of the nuts. You must not think I am "poking fun" at any one; I row in the same boat with my neighbours. Nevertheless, the practice reminds me of the plan they have for weighing pigs in the far West— they put a pig into one scale and stones into the other, and then guess the weight of the stones. The business is generally completed for this year, and I think that the result is that that the crop, though much exceeding that of last year, falls short of the expectations formed.

I will now resume my remarks on coconut cultivation.

Respecting the soil I need say nothing as that subject is probably settled for those who may peruse these letters. The next important matter, one forcing itself into greater consideration, is the selection of nuts for nurseries. In days of yore, when the object was to plant as much as possible in a short time, there may have been some excuse for error, in the plan adopted for procuring nuts. Advances were made for thousands of nuts to villagers; and, at an appointed time, an overseer was sent to select them. As estates came into bearing this plan was modified, and A. made his overseer select from his own heap of nuts, or from his neighbour's heap. Subsequently, A. selected the nuts himself. These methods should only be characterized by terms indicating different degrees of badness. I can perhaps most briefly make my remarks by putting them into the shape of propositions.

I.—Every nursery nut should be *known* to come from a healthy, middle aged tree, of a species bearing well in the same soil and locality as the ground to be planted.

1. Premature decay is frequently accompanied by profusion of blossom, so that a heavy crop does not necessarily indicate a healthy tree.

2. In vegetables, as in animals, disease is hereditary. In some districts of Scotland, the larch plantations are dying out, because they were raised from seeds collected from diseased trees which bear seeds in profusion. In England, the ash has deteriorated from the same cause,—seeds being most readily procured from diseased trees. The Hawthorndean apple is the most precocious and prolific, because it never produces a healthy stem.

3. It is a recognised fact in arboriculture that seeds, from very young or very old trees, produce weekly plants.

4. In selecting seeds for orchards and woods at home, a general rule, which is considered a safe one, is to select those kinds which thrive and bear best in the neighbourhood, as some species of trees are more affected by soil and local climate than others.

All must have noticed how differently the different varieties of trees, on a coconut estate, bear:—The king coconut, for instance, seldom bears even a tolerably fair crop in this district.

II.—Every nut should be *known* to have thoroughly ripened on the tree. Probably this is never the case with village nuts. Offers for twice the market value for nuts, thus left to ripen, have been refused by villagers. I would not say that every nut should be allowed to fall; but, at any rate, it should not be picked until we are certain that it has ceased to derive nourishment from the tree. The object of a vegetable's existence is to mature seeds for perpetuation of its species. To this end, it draws from the earth by its roots, from the atmosphere by its leaves, and even from its own substance, materials requisite for the highest possible combination of organic elements; and seems to task its energies to concentrate combinations in the seed. Cereals dry up and wither into straw as the grain ripens; deciduous plants shed their leaves after bearing fruit. How worn-out and sickly does a coffee bush look after bearing a heavy crop. Now, it is only as the seed or fruit is maturing that this highest development takes place, and hence appears the necessity for allowing the fruit to remain on the tree, as long as it will do so; for, generally, it detaches itself as soon as it ceases to derive nourishment from the tree.

III.—The nuts should grow on a short stalk. One of the most disheartening things we have to endure is the sight of bunches of nuts, from 4 months old upwards, fallen from the tree. This almost invariably arises from the length of the stalk preventing the nuts getting the natural support of the leaves.

IV.—The nuts should have as little husk as possible.

Particularly so when, as at Jaffna, the husk is valueless. Not only does the large husk require a large amount of valuable mineral matter for the perfection of useless husk; but as the greater part of our crop is in its heaviest stage just when we expect stormy weather, the risk of loss from falling nuts is decreased, in proportion as we lessen the size of the husk, which, at that stage, weighs more in proportion than the rest of the nut.

V.—The largest nuts are, probably, not the best for planting.

Trees with large nuts usually bear a smaller number, the husk of large nuts is usually disproportionately large, a larger number of them than of small nuts fall prematurely from the trees, and the kernel is usually thinner than in small nuts.

VI.—Round nuts are preferable to long ones.

A sphere is the figure which contains the largest amount of matter in the smallest possible compass. Long nuts grow on long stems, and have disproportionately large husks and small kernels.

If I am correct, it appears that nuts for nurseries should be *known* to come from healthy middle-aged trees, bearing well in the locality and soil to be planted; and to have ripened thoroughly on the trees. They should be average-sized, round nuts, with little husk, growing on short stalks. I would advocate the selection of certain trees on the old estates, from which alone the nurseries should be supplied; unless, equally good nuts, *known* to be grown under similar circumstances, can be procured elsewhere, for the purpose of "changing the seed." One such tree, carefully cultivated, would amply suffice for supplying vacancies as they occur in 50 acres of old cultivation, where supplies have been previously well kept up.

When this plan is adopted, there is little trouble in the selection of nuts collected from these trees. I think it is not exaggeration to say that *every nut of them will come to maturity.* If it is necessary to select nuts for the nursery from the heap, of which nothing is known, great care is requisite. This is perhaps the most fatiguing job on an estate, as three of the five senses have to be constantly "on the stretch," seeking for minute indication of quality, which, though they can hardly be described in words, are readily distinguished by those experienced in

selection. The experience is best gained by watching men husking nuts. The eye will at once detect some of the nuts which should be rejected, such as very large or long nuts, those with remnants of stalks attached to them, with longitudinal wrinkles, with dark circles surrounding the places where they were joined to the stalks, and such other manifest imperfections. If the nuts not rejected by the eye are now handled, some more will be rejected. It is usual to say that a heavy nut is a bad one, but this is a popular error. Weight is not *per se* indicative of inferiority: for a perfectly ripe, medium-size nut, with little husk, but thick shell and kernel, will outweigh a much larger nut, with much husk, and thin shell and kernel. A good nut may be heavy, but you hardly *notice* that such is the case, as it is springy and has an indescribable elastic feel, as if it would escape from your hands. The bad nut impresses on you a sense of weight, it imparts a dull sensation, you feel that you have a ponderous dead weight in your hands. Finally, if the nuts, after handling, are shaken near the ears, some more will be rejected. In perfectly ripe nuts the water will "rattle" with a sharp, clear sound; in an unripe nut it will make a dull hollow noise. Probably this is the most delicate of all the tests, as it is certainly one which cannot long be kept up, for the ear fails to perceive the distinctive sounds after it is fatigued. Sometimes the nut has dried so much that there is no water left to rattle, at other times there is so much water that there is no room for it to rattle in.

There are exceptions to every rule; and, perhaps, whilst strict attention to the foregoing rules would exclude all bad nuts, it might exclude also some quite fit for planting; therein lies one of the advantages of knowing the tree whence a nut comes; as, if that is known to be good, some mark of inferiority might be overlooked.

Perhaps, however, there is only one infallible criterion of a nut's ripeness: breaking it open to see if the skin on the kernel is thoroughly darkened. This test, of course, cannot be applied to nursery nuts.

In as far as there *is* truth in what I have said, it is "penny wise and pound foolish" to purchase for a nursery, nuts not *known* to be such as I have described, simply because they are cheaper. Suppose that I can buy nuts from the village, or select them from a heap on an estate, at 5s. per 100 –and can get nuts *known* to be such as I have described, at 10s. per 100. Is it not wise to pay the extra price as an insurance that I shall get healthy plants of a good description of nut? The apparent economy in purchasing the cheaper nuts is proved to be deceptive by the fact, that 10 per cent of nuts selected under the old system did not sprout in the nursery; and that 10 per cent of those planted out in the field died in the first year. Thus, one-fifth of the nuts planted were useless, and all the money spent in watering and transplanting them was thrown away.

When the nuts in the nursery have sprouted, (and probably as soon thereafter as possible), the seedlings should be planted out (say) 6 feet apart, in good soil near a tank. They should be left there at least two years, be dug round occasionally, manured as necessary, and watered daily in dry weather so as to force them on. When two or three years old they should be transplanted, at the close of the dry season, and previous to removal, should not be watered for sometime. If required to supply vacancies, the holes for them should be made large and deep, and partially filled with manure and soil. The plants should then be carefully taken up, with as much earth as possible; and, after they are placed in the holes, richly manured earth should be filled in round them. Plants, thus put out and freely watered for one dry season, will fully equal those put out after the old fashion, and will cost far less.

The advantages of this system are great when supplies are required for vacancies, as the two years' watering is so much more cheaply

performed, the plants can be so much more easily manured and *individually* cared for, and as they are so much more easily protected from being eaten by cattle; but this system would be peculiarly useful in opening a new estate, as it would postpone, for at any rate two years, the greater part of the expenditure, and above all, because it would allow of old plants being transplanted into virgin soil, an advantage, the value of which none can appreciate but those who know the injury sustained by virgin soil, from exposure to sun and atmospheric agency. I am not aware that this plan has been adopted in any new cultivation, though it has met with general approval for supplies: but the advantages of it are so apparent, that it will probably be employed in future plantations.

Respecting supplies I will not say much. I would draw a veil over our most common failure on estates here, but cannot pass the subject unnoticed. As most supplies are required to fill up vacancies where trees have once been, it should be remembered that those trees have abstracted from the soil, where the plant is to be placed, the *very substances* it requires to enable it to grow well: and also, that the roots of the old tree are left in the ground, and will for a long time keep the ground around them hard. Hence arises the necessity for making large holes for supplies, and of partially filling the holes with rich soil. The supply will grow well until the nourishment has been all extracted from that soil, and then it appears to be stationary. This is accounted for by the roots then entering into the soil which had previously been impoverished by the tree, formerly growing on the same place. This proves how necessary perindical manuring is, if we wish our supplies to grow well.

Yours truly,

"DELTA."

P. S.—Permit me to make a few remarks on *Publicola's* letter.

If M. Lépine's tables are correct, the capitalist who will not use them, "without first having proofs positive of their success," should invest his capital otherwise than in agriculture. There is no "haphazard" in applying, as manure, those substances which analysis proves to be the constituents of a tree. It matters not whether those substances are derived from the tree itself, or from elsewhere. Our business is to get Phosphates, or whatever else we require, wherever they can be got cheapest. There is no difficulty in procuring the manures suggested by *Delta*, and if M. Lépine's tables are correct, *Delta's* quantites, absurdly small though they seem to be, are actually *more than sufficient*. *Publicola* has valued some suppositious manure he writes of, at £10 per ton, and then shews that the use of one ton of it per acre would leave a small margin for profit. Had he valued the manure at £20 he might conclusively have shewn a dead loss. On the other hand, had he valued the manure at £1 10s per ton, and allowed 1 ton for 7 acres, he would have been nearer the mark; and might have discovered some possibility of making profit by its use. The truth is that *Delta's* mixture is as cheap as the quantity required is trifling. Its cost is about that stated above, and the only obstacle to its extensive application is the prohibitory price set upon salt by a *liberal* and *enlightened* Government. The prices of the articles required for the mixture are about the following in this district. SALT *per cent.* 9s. 4d.: lime per 60 bushels 12s; bones per ton £2; ashes per bushel (say) 1½d.

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* 25 tons of turnips were grown "two years running" on the brows of a bare and utterly soiless chalk down, applying by chemical salts which were the exact equivalents of the crop required, and that at a *less* expense than it cost three others to grow a smaller crop on the best of soil.

The price of the mixture would then be as follows :—

	lb	s.	d.
SALT (say) ...	30	2	6
Ashes	240	0	1½
Bones	56	1	0
Lime	15	0	0
Total per acre.	341	3	7½ or less than £1 10s. per ton.

I hope *Publicola* will not object to my questioning the propriety of his methods of employing poonac and coconut water; and of tying cattle round the trees. Poonac should unquestionably be passed through (full grown, working) cattle, so as to increase its value as a nitrogenous manure; coconut water should be converted into vinegar, and be employed to dissolve bones, lime or some other mineral manure; and, where cattle are so plentiful that two can be tied for 10 days round a tree, liquid manure tanks should be used. The dung, mixed with *green* weeds and mud, would ferment without the water of the nuts.

I would offer my thanks to *Publicola* for the information respecting coconut husk which I shall make use of. If the peculiar advantage of the practice recommended lies in the protection husks afford from the sun's rays and from drought, we have the advantage over other places,—the "lasting properties" would be more nearly 70 than 7 years.

The "Tabular Statement" is very interesting and useful, and will I trust be followed by others; particularly by one shewing how to *cultivate* an estate "on low sandy ground," where labor costs 3½ to 3¾d per diem for from 10s. to 12s. 6d. per acre. The statement carries with it unequivocal evidence of inaccuracy, can large and small estates be managed at the same average cost per acre? Must all the other expenses connected with an estate cost just half as much where labor is at 3¾d. per diem as they do when labor is at 7½d.? Will you get superintendents, overseers, artificers when labor costs 3¾d., for half the price paid, when labor cost 7½d.? Yet this is *Publicola's* statement, which I now put to the test.

At Jaffna the average size of estates is 300 acres. The price of labor (in some localities) is 3½d. According to *Publicola*, on such an estate, "the cost of cultivation, for superintendence, labor, watching, &c., and ALL OTHER INCIDENTAL EXPENSES, ought not to exceed £150 to £187-10s., For a calculation the following data are taken. There being no Resthouse in Jaffna, and no Agency House, it is necessary, that the superintendent should have a house in town, and travelling expenses allowed. A horse must be allowed as it is a necessity Where *cultivation* is really carried on, one overseer is not enough; but I only allow for one. I estimate only for some of those operations, the necessity for which is admitted in the letter published in your "Common-place Book" for 1859; of which *Publicola* claims the credit. I allow for ploughing 3 times per annum; and for digging round the trees 4 times per annum.

The calculation then stands thus :—

	£	s.	d.	£	s.	d.
Town and travelling expenses per month ...	2	0	0			
Horse's Keep " " ...	1	10	0			
Overseer " " ...	1	10	0			
6 Watchmen at 9s. " " ...	2	14	0			
Cattle herd " " ...	0	6	0			
	8	0	0			
or per annum				96	0	0
Ploughing 300 acres 3 times at 3¾d per acre " " ...				14	1	3
Digging round trees 4 times at 7½d per acre " " ...				37	10	0
Expenses on 150 candies of copperah at 2s. 6d. " " ...				18	15	0
Total per annum ...				166	6	3

If there be error above, it is on the side of low charges: unless I may have erred in the expense of digging round trees; having estimated the expense as incurred by the method we adopt here. The result is that the whole of *Publicola's* allowance is absorbed, without leaving one farthing for superintendence, stock, implements, fences, supplies, manure, or for any cultivation, beyond the most utter "rule of thumb" work.

I have dwelt upon this subject at length, because absent proprietors might consider *Publicola's* statement correct. There have been some estates managed, (not *cultivated*) at about the price; and I call all who have seen them to bear witness, that their progress has been from bad to worse; till some have come to that stage, that few could afford to take them as a gift, if bound to keep them up. Other estates, under the same circumstances, are getting into the same state, as fast as parsimony on the proprietor's part can drive them into it.

I must now carry the war into the enemy's territory. Having shewn that *cultivation* at Jaffna should cost more that than stated let us see what *Superintendence* costs elsewhere. The letter in your Common-place Book shews that *Publicola* knows well the Horekelle estate, 800 acres, in the N.-W. Province. If I am correctly informed there is connected with it

A resident Manager—who gets	per annum	£200 or 5s	per acre.
A travelling Inspector (that estate's share of whose salary can hardly be less than)	,,	100 or 2s 6d	,,
A Superintendent or Agent in Colombo, who certainly would not estimate his services at less than	,,	100 or 2s 6d	,,
Cost of Superintendence of 800 acres		£400 or 10s	per acre.

The cost of superintendence on a large estate is always less per acre than on a small one: yet, in the N.-W. Province, an estate of 800 acres appears to cost *10s. per acre for Superintendence alone*, or about as much per acre as *Publicola* would allow for the whole expenses on an estate where labor is cheaper

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PROPOSAL TO ESTABLISH STEAM MILLS FOR EXPRESSING COCONUT OIL AT JAFFNA

It is now twenty years since the first plantation of coconuts were undertaken by Europeans in Jaffna, and time has rudely dissipated the fallacious idea then generally entertained, that coconut trees once planted, and tended for the first two or three years would afterwards grow almost without attention, and give a handsome return for the small original outlay alone necessary for their cultivation.

Experience has now proved that a neglected *plantation of coconut* trees is valueless, and that unlike those in the small native gardens which are always highly remunerative, the trees in the European plantations afford no crop except in return for high cultivation and a regular supply of manure.

It is an axiom in all agriculture, that the produce taken from the earth must be returned to it in some shape, or a worse crop is exacted every year from the exhausted soil.

In the Jaffna plantations we *have hitherto* ignored this necessity, although the soil of the Peninsula is generally poor, and can the less bear the system that has been pursued.

The want of any means of local manufacture, and consequent export of the whole produce of the estates in the shape of copperah, has forced upon owners this ruinous exhaustion of the soil, which can be mitigated only by such other partial efforts at manuring which have been at their disposal.

It is believed that the best manure that can possibly be applied to the cocoanut tree, is "poonac" after passing through animals of which it is the most nutritious food, and the produce of an estate in full bearing would probably be at once raised 50 per cent, were all the poonac produced on it used as food for cattle and pigs, and thus returned to the soil.

This simple manure, so vital to the success of our plantations, is impossible in Jaffna, owing to the want of any local means of manufacturing our raw produce. Were the owners of estates to combine for this important object, its realisation should be easily attained.

There can be no question but that the establishment of steam mills would in itself be a lucrative concern, while the great want of the estates would at the same time be supplied. It is proposed therefore to erect such mills by a Company, formed by the holders of cocoanut property in Jaffna, upon the principles of limited liability, and this paper is drawn up, and circulated amongst proprietors, to see whether sufficient support can be obtained to carry out the object in view.

The cost of the necessary plant in England with freight, and erection on some convenient central locality amongst the estates, should not exceed £1,000, while an additional capital of £1,000 should be sufficient to carry on operations untill returns therefrom would be received. Mr. Cotton, of the Madras Civil Service, a proprietor now in England, would be happy to procure the necessary plant there, and to secure the services of an efficient Manager and Engineer, which offices should of course be combined in one person. A Committee of resident proprietors would superintend the management, by whom quarterly accounts of the operations of the Company would be supplied to all shareholders, and the books should always be open to the inspection of the latter.

All proprietors of estates, who were also shareholders, should be bound to supply all their produce to the mills at the current Jaffna market rates, repurchasing their poonac in the same manner. If the produce of shareholders were not sufficient to work the mills constantly, the produce of non-shareholders might then be purchased in the market, but the main object of the Company being to work up to the crops of the shareholders and return them the poonac, other work should never be taken up, while their produce was available.

The above is a brief sketch of the principles on which the concern would be conducted, and it is obvious that the time has not yet arrived to enter upon further detail. Such would be fitly arranged by the shareholders, if sufficient support is obtained to bring the proposed Company into existence.

It is intended in the first instance to confine the capital of the Company to £2,000, in two hundred shares, at ten pounds each, and gentlemen interested in Jaffna cocoanut cultivation are requested to intimate to Mr. Davidson, or Mr. Lindsay, the number of shares for which they are willing to subscribe.

It is proposed that a meeting on the subject be held in Jaffna in the month of June, when if sufficient support be obtained, the company will be established. One-half the subscriptions must then be paid down to procure the plant from England, and erect the necessary buildings. The remainder of the subscriptions would be called for when the mills are erected, and operations ready to commence.

(From the *Overland Ceylon Observer*, March 15th, 1862).

The method of raising, near tanks, nurseries of large plants, as detailed in my last letter, is susceptible of modification to suit the various opinions and wants of different planters at different seasons. By increasing the distances between the plants, when put out, they can be

allowed to remain until they are of such size as may be required; and, if kept till 5 or 6 years old, the operation of transplanting would generally throw them into flower the year after they were put out into the field.

It is probably judicious to root up, as it is discovered, every plant which appears not to thrive; not merely yellow or dying plants, but such as by having successive new leaves of the same length and size, clearly evince that their growth is checked. When this is not accounted for by the previous treatment of the plant, it indicates constitutional defect. Trying to restore it to health is labor and time wasted; not because no such plants can, by any means, be restored to health; but because the conditions essential to success are not available in field operations. If such plants are left in the ground, instead of being rooted up, forthwith, labor is always wasted on them, by some one or other, whatever orders to the contrary may be given.

After plants are put out into the field (indeed at every stage of their growth) there is probably nothing so beneficial to them as keeping the soil round them loose, and free from weeds. The size of the circle dug up should be proportioned to the size of the plants; the effect produced is to some extent proportioned to the depth to which the soil is loosened; for, *in the driest season, some moisture will pervade soil, to such depth as it has been loosened.* If correct in these statements, it appears advisable that plants should be dug round (not twice, or thrice or any fixed number of times annually), but whenever, and *as often as, heavy rain followed by drought cakes the surface soil.* Where ploughs are used it is probably only necessary to dig up such parts round plants as are left unploughed. I know not why such is the case, but we rarely dig round our larger trees, in the way just mentioned, unless manure has been applied.

Although in this Province there is no diversity of opinion as to the benefits of ploughing, I believe that elsewhere the advantages are not so readily admitted. I propose therefore taking up the subject in my next letter, but will digress for the present to the subject of feeding stock, so that I may have an opportunity of detailing the method of cultivating guinea grass adopted here.

Guinea Grass seed is sown, much as kurakkan and tobacco are sown, in well-manured beds, which are covered over with cocoanut leaves to protect them from the light. Within a week, some seedlings should appear:—dark green leaflets on pink stalks; and as their growth is very rapid, when three weeks' old, they are fit to be transplanted, and will then have three shoots. If the seedlings spring up too numerously, they should be thinned out, and those removed should be planted in beds, a few inches apart; when they will, if well watered, get on as well as those in the original beds. As some seedlings are removed from the beds others spring up, until the nursery appears to be inexhaustible. No seedling is too small to grow after transplanting, if well watered; but as the object here is to grow grass extensively, without watering, care must be taken that good strong seedlings only are put out in the field. Spindly, or too succulent, or too small plants will not thrive if put out in the field; a large proportion of them will die, in dry weather, however well watered.

The ground to be planted should be carefully prepared before the seedlings are ready, for *nothing is more important than to embrace a favourable opportunity for transplanting* them. It is perhaps advisable to level the ground a little before manuring; then cattle or sheep should be folded over it. Sheep manure is incomparably the best where procurable; but good grass has been grown when only dry cattle manure has been used. It is worth remembering that in all cultivation, manure and water are requisite. If then we may consider on the *complement* of the other, it should be remembered that in a dry climate more manure should be applied the less rain we expect. The ground when manured should be well turned up, and the manure well buried. Ploughing and cross-ploughing will suffice, but it is advisable to dig the ground two mamoties deep. This

costs here about 10s. per acre; but this outlay is amply repaid in superior grass, in the improvement effected on the coconut trees, and in the eradication of weeds and grass which injure the guinea grass. After being dug up, the ground should be carefully levelled; and it is then fit for lining. This should be done with a chain having links a foot long.* If parallel rows of strong pegs a chain apart, be first made, the intervening space is easily lined with small pegs, by stretching the chain between corresponding pegs in each of the parallel rows. It is advisable to leave unlined the space where the last row of pegs in each square chain should be placed. By thus doing, if the chain be 50 feet long, the ground is marked off into a plot 50 feet square with paths round each.

The ground is now ready for planting, and I would embrace a favourable opportunity for transplanting the seedlings. The best time to select is the wet season *when rain or showers may be expected*; the nearer approach that can be made to these conditions the better. A cooly with a small crowbar, or heavy pointed stick, makes small holes, and three persons follow carefully arranging the roots of the seedlings, in the holes, and gently pressing the earth round them. Abundance of water should be applied to the grass when planted, *whatever the weather*, as water "settles" the earth round the roots far better than trampling. If the pegs are now collected for use on future occasions the operation is complete. Nothing more is required if rain follow; but in dry weather it is necessary to water the plants for 3 or 4 days, until it is clearly apparent that they are growing.

Some think, I believe, that such care in the cultivation is a waste of time and money,—an opinion which can hardly be held by those who know the advantages arising from loosening the soil round cereals and of manuring from time to time. The cost of deep digging is amply repaid by the increase of nuts, &c., the cost of lining is a mere trifle, is repaid in regularity and ease with which the planting is effected, and in the facilities afforded for weeding, manuring, and ploughing between the rows.

In a month or six weeks from the time of planting, seed will appear on some of the plants, and then (if seed is not required) the grass should be cut down to within 4 inches of the ground, after which weeding should be effected and the ground between the rows should be loosened. Perhaps on a large scale a grubber, a drill harrow, or some such implement would be the best to employ for this purpose; but, on a small scale, and in a confined space, a native plough, drawn by two men, answers the purpose well without injury to the grass. This will now grow rapidly, and new shoots being formed will make it grow much thicker than before, so that weeds will be almost extirpated. In another month or six weeks another cutting can be taken, and now, after ploughing as before but in a direction at right angles to that of the first ploughing, liquid manure should be applied in the furrows. It may be worth mentioning that where the usual liquid manure is not available, dung steeped in and well mixed up with water, and then allowed to ferment sufficiently, makes a valuable liquid manure; if organic manures are to be used, probably lime and common ashes are the best; but where the object is not to allow the grass to mature its seeds organic manures are the best. Cereals, grains of all sorts, derive most of their nourishment from the atmosphere, until after flowering: when they appropriate all suitable matter within their reach to enable them to perfect their seeds. Guinea grass thus cultivated will, even in a dry climate, give 8 cuttings in 12 months. Doubtless with cultivation and manure it would continue to give good crops without removal of the plants; but, where any extent of ground is at our disposal, I am inclined to think that new ground should be planted annually; not only for the sake of the grass, but also for the sake of our trees. At any rate, when

* I say one foot long, because when ground is abundant it is judicious to leave room for manuring and ploughing: but, where it is requisite to economise space, the plants might be put out in rows 1 foot apart at a distance of 6 inches from each other—this would double the number of plants.

the same ground only is available, I would advocate taking up the old roots; separating and selecting from them healthy shoots; digging over the ground; and replanting it in such a way that the plants shall be in the spaces between the rows of the previous year. If true that plants excrete what is deleterious to them, this removal is necessary so that the deleterious matters may, by exposure to air, have a chance of entering into new and, possibly, beneficial combinations.

When the option is left, the best time for cutting the grass is when it is in flower; which is shewn by small dark-brown feathery tufts appearing on the "heads." If fodder be not required when the grass comes into flower, the flower stalks should be carefully pulled away as soon as they appear; the plant will then take a new lease of life, and continue to grow vigorously. If advisable to raise seedlings again, the seed is easily collected either by tying a bag supported by a stick round the "head;" or by passing the "head" through the loosely closed hand, when the ripe seed will fall as the "head" leaves the hand. When guinea grass is once established it is perhaps better to take up the old roots; and, by careful separation and selection, to secure good vigorous shoots to plant in new ground. To prove how easily this can be effected I may mention that one plant, not 12 months old, was separated into 88 plants for new ground. As guinea grass appears to throw out new shoots after each cutting, it is well to regulate the cutting of grass which is to be taken up, so that new shoots may be thrown out, and may be sufficiently strong before removal: probably 10 days after cutting they would be so. When the old plants have been removed, the ground from which they have been taken should be carefully raked, and then, after a shower, a fine "braid" of young seedlings will appear wherever seed had been allowed to fall. Perhaps to ensure a second crop after the removal of the old roots, healthy plants at regular intervals should be allowed to mature their seeds. As before recommended with the seedling nursery, so now, it is advisable to thin the seedlings, spontaneously grown, for the purposes of ensuring the vigorous growth of those left, even if plants are not required for extending the cultivation.

As I have said before, and contrary to preconceived opinions, trees which have had guinea grass thus planted round them bear better than before it was planted; and guinea grass grows fairly under the shade of coconut trees, though it does not "stool" so well or grow as luxuriantly as what is in the open sun. It was supposed that the grass would appropriate all the nourishment contained in the air descending to the coconut roots, and would "choke" them; on the other hand grass, not allowed to mature its seed, does not rob the soil of much; the manure is used by the tree as well as by the grass, the deep digging allows air to descend deeper into the ground, and probably a partial pruning of the roots of the trees acts beneficially. Above all, the grass keeps the ground permanently cool and moist, for there is not a night, however dry the season, in which guinea grass does not cause the deposits of some dew.

I have been thus minute in describing the process of cultivation here, because its successful cultivation is a matter of much importance in dry climates, and I am in hopes, not only that some may find the description of use, but that some residing in those places where it has always been grown, will suggest the improvements in the system which will benefit others as well as myself.

The advantage derived from extensive cultivation of guinea grass independent of the saving of the expense of grass-cutters, and of outlay for straw, &c., and of the ability to fatten pigs, cattle, &c. are many. Among them I may mention:

1.—Enough cattle can be kept on an estate to admit of ploughing the estate, *quickly*, whenever the ground has been caked by rain and drought; of dividing such produce, manures, &c., as we desire to cart, without anxiety.

II. Ground can be ploughed as it may be deemed advisable to do so without necessity of considering where the cattle are to graze.

III. Cattle can be kept, simply for manuring purposes, without fear that every blade of grass consumed by them is taken from the mouths of working cattle.

IV. Cattle can be stall fed, and thus working cattle can be kept in better condition than when their leisure hours are spent in ceaseless endeavours to pick up a precarious subsistence on the scanty herbage during the dry season.

V.- By means of stall feeding manures can be prepared in the highest state of perfection. Liquid manure tanks can be kept in use, &c., &c.

I do not mean to say that guinea grass would alone be sufficient or suitable feeding for *working* cattle. They require *nitrogenous* food for the purpose of repairing the waste of muscle and sinew arising from labor. Such food as poonac is necessary when we require a good day's work or a continuance of it.

Cattle will return the poonac as manure in a *more highly nitrogenized* condition.

"In vegetables," "Delta" says, "as in animals disease is hereditary." Did it never strike him about the sustaining or stimulating principle in nature which may be applied to trees as well as animals? Do we not often see a poor sickly, emaciated, soundless creature drag out his miserable existence by having something stronger than tea infused into him? So with poor sickly trees, as with men, they can of course be resuscitated, or be brought from the *non*-bearing to the *full*-bearing condition.

Nature is very eccentric; she sometimes leaves an object to languish and pine its miserable existence away, whilst she may improve another object in the same condition, showing how she can deteriorate and invigorate, as best suits her whims.

Now to sum up all "Delta"'s vagaries and caprices, he has heaped an immense number of ideas into one article showing what mere theory may establish, till at last he has wearied himself *so* thoroughly in *imaginary* that the only conclusion one can arrive at, is the absolute condemnation of his own system. So I gather from his article in your last and also from one showing the desirability of establishing an oil mill at Jaffna, which on his own showing would be no better than his planting freaks.

With all his crude fanciful ideas he gives a result of *actual* work, 150 candies of copperah on 350 acres of coconuts, after whiling away his time in the Northern Province for the last 10 or 20 years. What vanity! Why the most casual discerning proprietor would turn round and say what have you been doing *all this while*. If your theory be good in practice you ought to be giving me about 800,000 nuts at least annually, on your own showing as emanating from your wonderful pen.

Coconut trees can be dug about cheaply to a small extent without benefitting the tree, and in the same manner they can be manured sparsely and niggardly, so as to show little or no results but loss or waste of capital.

"Delta" says in his postscript *one* ton to seven acres of his manure will answer, and that it only costs £1 10s. per ton. What has he been vegetating upon so long? Well, gentle reader, 7 acres represent about 500 trees allowing for vacancies, *one ton to* 7 acres gives 4½ lb. weight to manure a *coconut tree*. Is "Delta" mad? -4½ lb. to a tree with its thousands of roots.

With labour, watching, keep of horse, overseers, &c., at such low rates as are current in the Jaffna Peninsula, "Delta" ought to do wonders. The estate about which he has been sputtering, I may tell him is turning out at the rate of 100 tons of oil for the year ending 30th

June next, although there are 150 acres from 6 to 7 years old and about 250 acres from 5 to 6. What is more biting to drones, "Publicola" two years ago took charge of an estate in the worst possible condition, and raised the produce the first year from 140,000 to 190,000, and for the past half year it has turned out 227,000, thus doubling its value almost in six *months*. All this must be sickening to poor "Delta" and his chums, and before contending with me again he will remember the French maxim "*Parlez peu et pensez bien.*"

Labor in this province has been nearly 7d instead of 3½d, watchers and cattle-keepers 15s instead of 9s per month, and overseers £3 instead of 30s. Where the keep of horse is £3 instead of 30s., everything is calculated at the double rate or so. Thus I hope proprietors will not be gulled by "Delta" 's chimerical views and fanciful calculations any more than they will take the false step of establishing oil mills on the flimsy principles set forth by "Delta."

Where did "Delta" learn that the up-keep of a large estate is cheaper than a small one? His own calculations are by the acre which prove him to be no authority on the subject. The general rule is to pay according to the amount of responsibility, and surely neither the charge for management nor superintendence will be so much on a small estate as on a large one. "Delta" wants to mystify the matter, and his calculations about superintendent, manager, and that quaint term "Inspector from Colombo," are all within the category of his other illusions.

(From the *Overland Ceylon Observer*, April 30th, 1862.)

Though the coconut has a pretty wide geographical range, and has been considered a most important plant in every country in which it grows, it would appear that it has generally been accepted more in the light of a gift of nature, than an object of human art and industry. Ceylon is the only country in which the cultivation has been attempted on a scale of sufficient magnitude to render the habits of the plant the subject of professional study to men of intelligence, and here, within the past twenty years, a fund of experience has been accumulated, of which it may be hoped the world will not lose the benefit.

A new agricultural undertaking labours under serious disadvantages in the most favourable circumstances, but coconut cultivation when first entered on as an investment for capital in Ceylon, had to contend with drawbacks peculiar to itself. Those who are new to a country and its productions, cannot be expected to possess a critical knowledge of soils and localities, suitable to a proposed cultivation; but in the case of many tropical productions an original error may be remedied. Plants of one or two years may cause loss of time and money, when they fail, but the capitalist and the planters are not bound to continue the struggle. The coconut, however, is a plant that takes from ten to fifteen years to answer the question that the planter puts to nature through it, while it is expected to remain a source of profit for three-quarters of a century; if therefore its cultivation be undertaken in ignorance of the conditions of success, a primary mistake is the parent of a life-long battle, where subsequently acquired experience, scientific knowledge, and doubtless industry will barely enable the planter to hold his own ground.

Those to whose lot it fell twenty years ago to select land for this cultivation, were unfortunately for themselves, and the progress of this branch of colonial industry, profoundly ignorant of the subject. The plant was found flourishing on the sea-shore; therefore sand was its natural habitat. It was said to be possible for the plants to yield fruit in the seventh year; therefore a large plantation was to be generally in bearing at the end of that time. The price of waste land was known, the price of

clearing light jungle was known, and the other expenses were estimated at a mere trifle. The cost of a coconut property was thus to be a sum scarce worth mentioning; while the annual produce per tree was taken at the very highest rate, that could be heard of in the best native gardens; so that a very excellent case was made out in favour of this as a paying investment for capital. For the first seven years things were hopeful; though the estimates of expenditure had been exceeded, and the plants were not yet in bearing, and it began to be said that the bearing in seven years was a mistake. Still there was hope; but as years passed and the plants were only found to struggle into bearing, and to yield a much lower produce than that calculated on, it was gradually admitted that coconut planting was not to be the first class investment that it had been originally given out to be. Year after year the tone of the planter has saddened down, till culture and manure have now become his only hopes. The case is bad enough as it is, but it would have been still worse, but for a circumstance that could scarcely have been foreseen twenty years ago. The price of coconuts has risen eighty per cent in the last fifteen years; this has not only saved the older estates from ruin, but will probably give a fresh impetus to the cultivation, both in the improvement of existing properties and the formation of new ones. The owners of the former may take for encouragement the fact that no plant responds more gratefully to anything done to improve the soil in which it grows, while those who now invest their capital, need not to choose their locality without consulting those whose experience can point out the best, or at least the lands that are naturally suited to the cultivation. There is an old proverb which says: "He who is his own lawyer has a fool for his client." He would be no less a fool who would purchase land for coconut cultivation, without learning all that science and local experience has already done, in discovery of the conditions on which nature will respond to the call made on her by the cultivator.

It would hardly be possible to overstate the importance of the selection of land for coconuts. It is possible to point out land planted twenty years ago, on which the few trees that still exist, have stems two feet in height and leaves from two to three feet in length; as for yielding fruit at any future time, of course, that is a thing out of the question. There are other spots where trees several years younger, and for which nothing has been done, but what was absolutely indispensable, yield average crops of 100 nuts per tree. Between those two extremes there may be found every degree of utter failure up to one of the best paying investments, into which capital could find its way, and all depend on bringing to the task a competent knowledge of the value of soils, founded on the signs which nature has impressed on them. In acquiring this kind of knowledge there is no great difficulty, to an earnest mind, in a country where the plant is to be found growing in every kind of soil, of every age, and under great variety of treatment. A man needs only a watchful eye to observe facts, and a reflecting mind to turn them to use. A habit of looking up at the tree and down at the soil, will in process of time, enable him who practises it, to give the true value of every shade of colour, every degree of inclination, every difference in composition or consistency that may come within the field of his observation—some knowledge of botany, chemistry and geology will be an indirect aid in the practical study of the value of soils, from the habit of minute observation which they demand; but a pocket case of reagents, a dried herbarium, and a geological hammer, are not the proper tools for the work. It is only experience that will avail, and the experience of a keen observer, and a close reasoner too.

Whatever may be the case in other countries the coconut requires an average temperature of not less than 80 degrees in Ceylon. I have myself made the experiment on a coffee estate, at an elevation somewhat under 300 feet, and where the average temperature was 75 degrees, and the range throughout the year only 10; the soil was of the very finest quality,

yet at the end of two years, the plants had made less progress than those planted at the same time, in the same district, and with no advantage other than a lower elevation, and consequently a higher temperature, made in six months.

As far as my experience enables me to judge, the advantage of sea air to this plant are generally over-estimated; where a suitable soil and temperature are to be found, the only consideration should be the cost of transport. I have no doubt that to the north of the mountains, coconut could be advantageously grown, right across the island, from Puttalam to Batticaloa. Perhaps, however, the best districts to seek land in at the previous time, are those between Matara and Hambantota on the South Coast, and between Negombo and Puttalam on the North-West. The tract of country that lies between the central mountains and the South-west monsoon is too wet, and the North-East Coast is probably too dry. It is unnecessary here to enquire into the causes of the poverty of the lands on the South-West Coast, the fact must be admitted by every one who has given any attention to the subject. The ridges are dry hot gravel washed by the rains for thousands of years. The flats are either clay, always cold and retentive, often swampy; or loose sand so poor as to be almost void of the elements of vegetation over considerable extents. It is not to be denied that even in worst districts, pieces of good land may be found, but they are few, of small extent and wide apart, in the best. After passing Negombo on the one hand and Matara on the other, the character of the soil gradually, but decidedly improve; the ridges become less gravelly, the clays less stiff, and the sands more loamy, while the colours become deeper and darker in each case. It is true as the soil improves the climate becomes less and less healthy, but this is one of the penalties imposed on mankind in their task of subduing the earth, and is not much as to deter skill and labor from running all risks if capital be forthcoming. Experience proves that fever deserts a highly cultivated district, and those who face it during the transition period, should be prepared with all known means, whether preventive or remedial, to counteract the effects of the polluted air.

In any land with the exception of a cold retentive subsoil, it is possible to obtain annually from one acre 10,000 nuts by heavy manuring and high cultivation. But it is evident that this will take less manure and less labour in proportion to the natural fertility of the land. The question in selecting lands is not what may be done by manure, but where the natural oil will do without it. I have already said that lands have been planted that in their natural state would not even grow the plant, and that almost without cultivation I have known land yielding 5,000 nuts per acre. In the one case a new soil would have to be made, and enriched with all the elements necessary to the coconut, before reaching the point of the fertility from which the other starts. As to the making of a soil, let it be remembered that 135 cubic yards of material will only raise the surface of an acre of land one inch, so that blending the old and new material into a soil six inches deep would require above 100 cubic yards of the latter. The cost will be calculated from the local price of labour and the distance from which the material had to be brought, but the cost would be something pretty considerable under the most favourable set of circumstances, and a mistake as to to value of the material applied would render the whole of no avail. It may be safely asserted that the mixture of two poor soils will not make a rich one, but they may often make an improveable one, while neither of them is so separately. Heavy clay laid on sand or gravel will only improve the constitution of the soil so far as to render manure applied to it more effective and more lasting in its effects. Even if the mixing of materials to form a soil were proved to form a fertile one, and the operation a paying investment, we of this generation have nothing to do with it in the formation of new properties, whatever we may do in the improvement of the old. Let us seek out first-

class lands now, such as nature has constituted suitably without our aid, and leave our great-grandsons to make the most of the second and third class, when free governments and free trade have doubled the population of the civilized world and quadrupled its purchasing power.

The great drawback to coconuts as an investment is the long period that must of necessity elapse before any return is obtained. During ten years money is always going out and nothing coming in, so that when a property does begin to pay, it has not only to yield the usual profits of capital but bridge up a long leeway. To obviate this drawback, native proprietors are in the habit of exhausting the land by secondary cultivation, while the coconut plants are young, and this is continued as long as anything can be obtained in return for the necessary labour. The disciples of Liebig need not to be informed that this custom would be more honoured in the breach than in the observance. The natives, however, cannot understand any connection between the failure of the coconuts and the crops of grain, roots or fruits that they have taken off the land. The enlightened cultivator chooses land that when his trees bear will yield him 3,000 nuts at the very least per acre annually. He makes up his mind to an expenditure of from £12 to £16 per acre, before he can obtain a single penny of return, and he resolves to return to the soil a full equivalent for every ounce of produce he removes from it. These plans carried out in in their integrity will ensure an annual rent of £6 per acre for a period not less than half a century. On the other hand if a man becomes involved in the cultivation of inferior land, he may have to struggle through life to make a living out of it; if the cost has been miscalculated the property may be brought into difficulties not to be surmounted; or, if he should lose his confidence in the undertaking, he may sacrifice all his labour, to the making of the fortune of some one, whose pluck is backed by ready money.

BY A WESTERN PROVINCE PLANTER.

(From the *Overland Ceylon Observer*, May 30th, 1862.)

When land is once purchased with a view to cultivation, the owner need speculate no further; when he has made his selection, skilfully, he will have nothing to regret in the future. I have already intimated my opinion, that any one wishing to purchase coconut land may, if he will take the proper means, secure what is suited to the purpose, and if it turns out otherwise he will have no one but himself to blame.

Though an allotment of land may have a general character, it is perhaps impossible in any part of Ceylon to find 10 acres together of uniform quality; a wise man will, therefore, give the closest observation and the deepest reflection, he is capable of, to the appropriation of the land, before he puts a plant in it. He will mark off the portions to be left unplanted for the present, and after clearing the part he proposes to cultivate, he will select only the finest pieces for coconuts, leaving aside the inferior quality for pasture. It has always appeared to me one of the greatest errors of our early planters, that they have generally planted up the whole of their available land with coconuts and left no resource for future improvement; yet there is no truth better established than that manure will, when applied in sufficient quantity, double and even quadruple the natural produce of the land, and it is well known too, that the same manure which will double the fruit of a heavy bearing tree, will have comparatively little effect on a barren one. What good will it do me, however, to know that I may increase the produce of an acre from 1,500 to 6,000 by the use of manure, when I have no manure to use?

Let us take the case hypothetically: say I have 500 acres of land, which it is my wish to make the best of as a coconut field, say that my reasonable prospect from this land, when it comes into full-bearing, is 1,000,000 nuts per annum, if I plant it all up; but if I have a full

command of manure, I can take 2,000,000. I know, however, that if I plant my land right through I have no means left of manufacturing enough manure to cause any increase on the permanent produce. On a detailed examination of my land I find that 100 acres is of a quality to yield naturally from 3,000 to 4,000 nuts per acre, that 250 will give an average of 2,500 and the remaining 250 acres will average no more than 1,500. I decide on planting only 250 acres, the natural produce of which will be 725,000. I clear the remaining 250 acres and make a cattle run, on which I can keep 170 head of cattle. This will enable me to commence manuring from the very first, to force forward the lagging plants, and to bring the whole into bearing two years earlier than if left to nature. Instead of straggling into bearing during a period of from 10 to 15 years, my trees will come into full-fruit simultaneously over the field, and with my means of manuring I will have every acre wrought up to an annual yield of 4,000 nuts in the 12th year; the same system continued will bring it up to 6,000 by the 20th year, nor will the improvement cease even then, for every particle of fertilizing matter brought into my land is a permanent gain, while I remove none of its products but the oil.

Chemists tell us that the elemental constituents of coconut oil are carbon, hydrogen and oxygen; and vegetable physiologists tell us that growing plants decompose water and atmospheric air to obtain their supplies of those elements. As the supply, therefore, is inexhaustible the removal of coconut oil in any quantity does not tend to impoverish the soil. Let me restore to my land the leaves, husks, shells and poonac, in some shape or other, and keep it up to the same degree of fertility for ever, while all that I introduce from beyond its own boundary, adds to its fertility, either in furnishing direct food to the plant, or improving the texture of the soil.

Though I believe in the soundness of the above views, I would not have it understood that I have seen them brought to the practical test. It would take an average life-time of earnest perseverance in one unchanging purpose to place them among ascertained facts, but several years' study of the character and habits of the plant has fixed an idea that was floating about in my mind long before I had any practical experience of this cultivation. If I should live to carry through certain experiments I have now in hand, I will be able to throw a steadier light on the subject.

MANAGEMENT OF CATTLE.—There was a breeding stock of cattle placed on a coconut estate when the trees were eight years old: the number at first was under 40 head, but by the twelfth year they had bred up to 101 head. During the subsequent eight years there was an average of 30 calves produced annually, there were none sold and none draughted off into the working stock, but the number never rose above 150 nor fell below 130. They had bred up to the limit of their food and the deaths of of necessity balanced the births; about 75 per cent were calves within the first fortnight and the remainder the old and feeble. About the middle of the 20th year the number of stock was 145 head bearing the aggregate local value of £130. In the course of the 21st year, 50 head were sold for £60 and at the end of it 115 head remained of the aggregate local value of £150. The only object in keeping cattle in this case was the manufacture of manure, as it is on all estates the number kept is greater than those necessary to do the draught work on the place; but there was a false principle acted on throughout, namely:—" The more cattle the more manure." This is only false relatively, for it is true of stock so long as it is kept in full-feed, vigorous health, but it is false when we put three animals to pick up livelihood where there is only food for two healthy individuals.* The above facts show that while £30 per annum might have been added

* "Hullo!" said one Yankee farmer to another, "what are you fencing that land for? A cow would starve on 40 acres of it."—"Yes, I know that, and so I am fencing it to keep the cattle out.—COMPILER.

to the proceeds of the estate by the sale of cattle that was thrown away in a baseless endeavour and a futile one to get more manure than the produce of the land would yield. The result of a change of system was that a greater bulk of manure as well as a better quality was produced from the reduced number of cattle, than had ever been made on the property in a like period before, and from its superior quality it produced more effects on the coconuts where it was supplied.

The first object then is to regulate the number of the stock on strict accordance with the means of feeding it. The experience of centuries has put a proverb in the mouths of the graziers of the South-West of Scotland, "under-stocked land may pay, but over stocked never will" and the fact is as much a fact in Ceylon as in Scotland. Let us proceed on sound principles and we will always come out of our enterprises at the right end. Our experience may not extend everywhere, but *let us creep before we attempt walking.* A neighbour of mine, the manager of a coffee estate, had planted his ravines with Mauritius grass. It soon grew far beyond the consumption of his single milk cow, and he gave £75 for forty-five head of coast *bullocks. In six weeks there was scarce a green blade left*; in three months forty head of cattle had died. In three months more the grass had once more passed beyond its bounds, and a fresh stock of forty head was purchased; in nine months the whole stock was reduced to fifteen head which *it should never have exceeded. I had another* neighbour I lived beside for ten years, who had the means of feeding thirty head of cattle, but he regularly during all that time purchased whenever he could get them cheap, and for anything I know continues the same to this day. *On the other hand* I have known a breeding stock of cattle kept for seven years without a single death among it, and I have known one instance and one only in Ceylon of cattle feeding being made directly profitable. The process was to purchase lean but healthy animals, stall feed them for three *months and then sell them to the butcher.* This sytsem is peculiarly suited to coffee estates where the means of feeding is confined to Mauritius grass in the ravines; but a breeding stock is most suitable to natural grasses provided the number be kept strictly within the amount of food that the land *produces.* The most that can be expected of such a stock is that the sales will cover the outlay connected with it, and the draught stock be kept up from the breeding stock instead of by purchase.

The first means of preserving a cattle stock in health is full feeding. Epidemic diseases almost always originate among the weak and half starved, though it may reach the healthy and well fed by contact, it is less fatal and spreads less rapidly among these. At one time there was almost an annual murrain among the draught bullocks on the Colombo and Kandy road that swept them off in hundreds. For the last seven years such a thing as murrain has scarcely been heard of on the roads, while thousands were taken off in the villages. The cause of this is evident, the large strong coast bullock has superseded the small native breed on the roads—the former represents from three to six times the capital invested in the latter, the former are trained from their calfhood to dry strong food; the latter refuse everything but green food and prefer picking it up for themselves. Fresh grass alone does not communicate the stamina to stand hard work even when it can be had in abundance, so wet weather and heavy roads fit them for disease. On the other hand when food is scarce, an insufficient supply is equally productive of the conditions that induce disease. The owner of a coast bullock cannot afford to starve him, as he costs from £5 to £12, and immediately falls off in condition and in strength unless he gets dry straw, poonac and kollu, and is regularly rubbed down and washed and in fact treated with as much care as a valuable horse. The cattle now generally employed on the roads are fine strong well-fed and well-tended animals, some of them within my knowledge costing £25 per pair; and while this is the case

the occurrence of a serious murrain on the roads is among the least probable of possible contingencies.

Besides being full fed a breeding stock should be dry housed: they want protection from heavy rains, chilling night dews and the midday sun. The working stock should be well and strongly fed at whatever cost. Paddy-straw, if to be obtained, is the best when supplemented with as much poonac as they can consume. If paddy-straw is not to be had, guinea grass hay must be provided grown out of the coconut field, if there is any spare land, if not as may; for that or an equivalent must be had in proportion to the demand. Where poonac is produced on the estate the young cattle should be taught to eat it from the first. A handful of salt thrown into the trough or tub will generally be sufficient inducement; it is often much harder to break a young bullock to a new kind of food than to the yoke when an early beginning has not been made. The working stock should be rubbed down daily with dry straw or a coarse cloth and well washed at least once a week.

If there is both a breeding and working stock kept, the oldest of the latter should be sold off as young ones grow up to supply their place -the best age to sell at is seven years, because the animal is then in his prime and has still a great deal of work in him if well cared for. A working stock of 40 head will be kept up by breaking in 10 three-years old every year and selling ten seven-years old.

MANAGEMENT OF THE CATTLE MANURE.—Every one believes in cattle manure; we have our hypotheses respecting other fertilizers, but for this we have proof positive. Not a coconut planter in Ceylon but will readily own that if he could create a supply of this article equal to his wants, he would no more complain of obstinately barren trees and generally small crops. He would go on rejoicing and, like *Publicola*, double his produce every year. The supply is however in every case limited by natural barriers, and the most skilled can do no more than turn to the best account so much of it as his circumstances furnish him with, after he has made the most of them.

The food eaten by cattle contains most of the elements of vegetation if not all, and in the process of digestion there is withdrawn by assimilation, carbon, hydrogen and oxygen with small portions of the salts and phosphates; but there is added bile, pancreatic juice, mucus, and other animal matters to the dung, while the urine is said to contain no less than 21 ingredients, many of which are the bases of acids, all are soluble in water and all are direct food for growing plants. Turned into the ground fresh, there is no doubt that the dung and urine of cattle will produce a great and immediate effect on the plants, with the roots of which it is brought in contact, but this is only a better mode of applying it than letting it accumulate in a dry cattle shed without litter till it is a foot thick and trodden as hard as a brick, or throwing it out in a heap to roast in the sun several months. We should however avail ourselves, to the utmost of our means, of the property of cattle manure through which it reduces by fermentation ten times its own bulk of fresh grass or succulent weeds, five times its own bulk of dried litter or leaves, twice its bulk of inert rotten wood and three times its bulk of fresh peat. Every coconut estate will afford a greater or less supply of annual weeds: in most neighbourhoods there are swamps that grow coarse grass or fern, some will have the command of rotten wood and some of a peat bog; but in the absence of all those resources any one may fall back on the leaflets of the coconut trees itself—anything is better than to lose the advantage of that property of the manure by which it fits an inert and otherwise useless substance for the food of plants.

I have under my charge a coconut estate of 300 acres of age and to be in full bearing, but its annual bearing is only 350,000 nuts or 1,160 per acre. *Publicola* would say that the avowal is not creditable to me, and it would certainly be true if my incumbency extended

ficient time to produce an effect; but how much can be
elve months when a new comer has to study his resources
isting system of management before he can take action in
ie one or superseding the other? The resources that had
years been utterly neglected were a cinnamon garden of
acres, that in the state in which it was kept would have
fle enough for 500 head of cattle, and nearly 100 acres of
d low jungles, some parts of which might be made grazing
s would supply litter and the very worst would furnish
lay to improve the texture of poor sands. But roads had
ied before any of those resources were available, the sys-
ernal cheap and inefficient management had to be changed,
money had to be expended in every direction. A manager
n twenty years' standing can tell that a large and sudden
expediture is not the direct road to the hearts of non-
l agents and proprietors, therefore a liberal system of expen-
ild be made to come on them like old age, till a return
as to come in when a bolder policy may be adopted. My
i was in the first place to increase my bulk of manure and
the manner that appeared to me most effective; as soon
its were matured I brought six single bullock cart loads
id weeds from the cinnamon field daily and put them into
sheds. At the end of three months there was about two
of manure accumulated; the cattle were removed to ano-
and the mass watered if it appeared to dry for the process
ation, and after lying for another month it was removed
l a single bullock cart load laid in the centre between
spread equally over the surface and dug in. In this way
h 80 head of cattle, manure one acre every week. The
almost entirely fed on the coconut field, and the cost per
ling tendence of cattle, collecting and transporting litter,
t the manure and digging the land, is as near as can be
25s.

ot prepared to assert that this is the very best manner
and applying manure, but in the present state of my know-
ow of nothing better. I wed my mind however to no theory;
perience and hints from other sources may change my practice,
meantime I recommend it to others, such as it is, as a
nce on certain more slovenly and wasteful systems that
non use.

ears to me that spreading the manure and digging it in,
a sounder principle than that of placing it in a circular
id each tree. The roots extend through all the soil, so
ver manure is put they immediately come in contact with
ow out fresh ramifications into it. Those fresh roots not
o the food furnished by the manure in the course of its
ion, but they forage about in the surrounding soil and imbibe
ters other than what has been put indirectly in the manure.
re is confined to a small space, there is no general stimulation
s; the grass is soon penetrated in all directions with fresh
ted suckers, but they do not extend more than a few in-
the surrounding soil, while everywhere else the old roots
inactive appearance. It is not improbable that the chemical
manure on the soil is brought into contact with in some
ers some elements soluble that were not so before. Were
the same quantity and quality of manure would produce
ffect in all soils, but every one knows that this is not the
hat effect is different with texture and composition in the
ht permeable soil, however poor in its original character,
es a better return for any amount of manure put into it
vy compact one.

GERMINATION OF COCONUTS.

Cocoanut cultivators in Ceylon will be interested in the following accounts of experiments on the Madras Farm; Attention having been recently directed, in several scientific journals, to the possibility of hastening the germination of hard husked seeds by steeping them in solutions of different salts and acids, especially in solutions of sulphuric acid, an experiment was made to test whether the germination of cocoanuts could thus be hastened. For the experiment ten fresh cocoanuts were taken, and they were treated as follows;—

Experiment.

No. 1.—Two nuts, steeped in water.
„ 2. „ „ with 5 P.C. of sulphuric acid.
„ 3.— „ „ with 10 P.C. of „
„ 4.— „ „ with 15 P.C. of „
„ 5.— „ not steeped.

The nuts were kept in the water, and solutions, for five days. On the 1st of December last, the whole of the nuts were planted in a piece of suitable soil. The soil was watered when necessary. On the 12th of March one of the nuts sent up a vigorous shoot, but the others having failed to send up shoots, they were all dug up on the 31st of March, when they were found in the condition stated below:—

Experiment.

No. 1.—Both nuts had germinated well, and produced vigorous shoots.
„ 2.—One nut had germinated, the other was rotten.
„ 3.—Neither of the nuts had germinated, but both were in good order.
„ 4.—One of the nuts was just commencing to germinate, both were in good order.
„ 5.—One of the nuts was just commencing to germinate, both were in good order.

As far as can be judged from this single experiment, steeping in acid solutions seems to retard rather than to facilitate the germination of cocoanuts, while steeping in pure water hastens germination. The subject will, however, receive further attention, and other experiments will be instituted.—*Tropical Agriculturist.*

COCONUT SUGAR.

(*Copy.*) HYDERABAD ESTATE, BATTICALOA,
November 27th, 1849.

Messrs. LEMARCHAND & Co., Jaffna.

GENTLEMEN,—I am in safe receipt of your favor written in reply to the questions addressed to you, and I beg to offer my very best thanks for the same, conveying as it does most new and valuable information about the subject which is now occupying a great deal of my attention. I neglected writing till I could more satisfactorily give you a kind of result of our trials, and from which I hope you may draw the same conclusions that I have, As for the palmyra toddy, I consider that at present the most important affair in Jaffna, and only wish I could have a chance to try what could be done. I myself think that the fact of the season beginning and ending in three or four months a great advantage indeed. I make no doubt that the paane could be purchased from the natives at a remunerating price, and that they would get to prefer so selling it, to making that abominable compound which they do now. I have proved that paane can be bought always in all seasons, in the hot sun or rainy weather, in the land wind or monsoon, $5\frac{1}{2}$ miles in chatties on coolies' heads, not reaching me till 1 p. m., and yet not suffer any deterioration whatever, and that from it, however highly limed it may be, a most superior quality of Muscovado sugar can be made. The weather is now so very rainy that I can do nothing, but when it clears a little, I will try and get some more and make you a sample. Even that excellent sugar you sent me deliquesced considerably on the

am afraid that mine, being still only Muscavado, would do so
ill I chance a few grains in this letter. Our experiments are
icient to determine precisely whether bark or lime should be
onsequence of recent discovery I am inclined rather to the
there is then no *risk* of fermentation taking place. This day a
ie subject with samples goes to the Asiatic Society—whom I
sted to have a full report thereon made and sent to the papers.
doubt they will do so, and then you will see the whole detailed,
e have yet gone.
urious to hear what the Jaffna planters say, and if they have
yet on any of their bearing trees. Also, if they anticipate that
ave any difficulty in obtaining toddy-drawers. A friend writing
affirms that we shall not, but that any number can be procured
re, Tanjore, &c.
other has made a very fair trial on two small trees, having tried
months, 7 paales were cut altogether on the two trees, eight might
cut, but one was left in the middle of the experiment and now he
he trees run to nuts, as a further proof. Each preceding paale
only larger than the one before and yielded more toddy. The last-
ielded the most. A paale will run 40 days cutting twice a day.
the toddy may be taken down once in 24 hours, and in the
e paale only stirred. The *first* 30 days the two trees yielded on
3⅛ pints each per day. The *second* 31 days they gave

$$\begin{array}{r} 4\frac{1}{8} \\ \hline 2)\ 7\frac{1}{4} \\ \hline 3\frac{3}{4} \text{ average.} \end{array}$$

he question whether the first month should be counted. Thus a
to be able to acquire, as it were, *a habit* of giving toddy; and
he more it is cut the better. The paales which have come out
abundance of nuts now on the flower stems. Adding the ⅛th of
not cut, we have, on the average of the two months, about 180
annum from a tree, and, taking the second month, over 200 or
ctly 200. I am sure this is much more than anyone expected.
processes I see no difficulty which may not be overcome, or
ich has not been overcome, and on the 1st December we hope to
50 trees, but that depends on whether we can get certain bails

only further to say that if any planter in Jaffna wishes for
n on any particular point which I can afford, I will do my best
him. I dare say they already number among them some sugar
I have a book by a Mr. Whitehouse of Jamaica; is he any
your son-in-law?
is possible, as I am acquainted with most of the late discoveries,
ther improvements in the art, that something may occur if they
to try, and if in time, for next palmyra season; if any one
riously of it I would be willing to come to Jaffna (if I could get
assist them to erect any works necessary or forward any plans
s of the same on remunerating me a trifle for the loss of time.
some things particularly needed by this paane (as it seems now)
erent from what is necessary in the case of cane juice; but if
rocure and boils some paane they will soon see it, as our paane
5. Because there is no fear but every gallon will yield a pound
ado sugar, and my trials lead me to think that 1½ lb. may be
. None of my experiments have been quantitative ones, it
done in open earthen chatties.
the refining of the jaggery, it can be done: and I have done it,
uch better to act on the raw material! Notwithstanding when
opens I will ask you to buy and send me some for a trial on a
, say perhaps a ton. I will advise you of this.

Meanwhile, I have made this quite public. I shall have no secrets though of course the practical part of the business can never be explained; it must be seen and experienced. The cost of apparatus however will not be very great. If any one is going to set about it in, as I said, in time for the palmyra, they should lose no time.

With many thanks, I remain, gentlemen,

Yours faithfully,

(Signed) J. GLANVILLE TAYLOR.

A few lines in acknowledgment will be esteemed a favor. Please tell me if the sample arrived at all presentable, and if so what the sugar is priced at? If it is really in good condition when you get it, perhaps you would let Mr. Dyke see it? Perhaps you have heard also something or other new on the subject since. By the bye you omit to say which sized baskets are sold 300 for a shilling. I should like to know the nett weight (minus baskets) of a given number of baskets, their size, and price: you do say 8 to 10 baskets one pound weight, but not which kind size is here specified. We have not got to make such good sugar I think when Capt. Reddie was here. This is made by a new process discovered lately.

BATTICALOA, Dec. 7, 1859.

We believe in coconut trees as firmly as ever when fully manured, but with manure I fear we have seen the best that they can do. Certainly we have had very trying weather—out of six years four were years of severe drought and when the rains came it was in floods that ran off the land without fertilizing it. The last year has been favourable, but the trees take long to recover. Our nuts are large and heavy. I have had them 940 to a candy but generally it takes 1,000. It is remarkable that some who planted nuts from Galle find their nuts lighter—1,200 to the candy. I wonder if the converse would be true—that is our nuts planted at Galle? It would be worth trying: the difference is upwards of 20 per cent.

Your very truly,

JAS. C. SORTAIN,

DEAR SIR,—I have the pleasure to send you as requested a corrected list of the estates and some statistics which you may find useful. I dare not mention the names of estates lest I thereby lose opportunities of carrying on my statistics.

In 1857 it was estimated that there were 24 estates, on 21 of which there were planted between 1841 and 1853 as many as 7,183 acres. On 6,260 of these acres the crop counted (and probably secured) was in 1857 up to 1,106,560 nuts; of the other estates I had not the statistics. On the next sheet I shew you the increase annually on same of the estates beside some other statistics.

NUTS PICKED ON SOME ESTATES FOR 7 YEARS.

Years.		Nuts.	Nuts.	Nuts.	Nuts.	Nuts.	Nuts.
1852	...	7,169	...	...	...	...	...
1853	...	27,760	14,859	...	...	...	13,336
1854	...	32,405	...	1,258	137	2,155	19,235
1855	...	22,590	30,956	3,086	201	6,812	7,348
1856	...	62,614	40,954	25,757	2,248	16,555	45,810
1857	...	102,698	65,225	66,001	8,914	22,739	68,030
1858	...	162,293	167,951	...	...	...	...

I find that I have not by my side any more statistics I should like you to make public, but can send you some more when I go to Karandhi. You are doubtless aware that this has been an unfortunate season for us, the crop falling far short of that of last year. However, next year's crop will doubtless give more than the usual increase as in the first and last estate quoted above after the reduced crops in 1855.—Yours truly,

JAFFNA, December 10, 1859.

THE COCONUT TREE ON THE WEST COAST OF INDIA.

(From "*British and Native Cochin*" in 1860.)

BY C. A. L.

Cause of Malabar being peculiarly favourable to its Productions—Modes of Planting—The Apple—Progress of Generation—Length of Life—Employment of the Roots for Fuel and Medicine—Nature of the wood—Picturesque Appearance of the Avenues in the Topes—Use of the Leaves for thatching Houses, &c.—Tapping—Drawing Toddy; its Consumption and Manufacture into Arrack, Sugar, Cement, and Vinegar. The Husk—Coir Fibre, Yarn, and Rope—The Shell—Kernel, Water, and Milk—Coconut oil, its Utility to Man in all Lands—Thoughts suggested by the Tree.

The superior character of the alluvial sandy soil throughout Malabar, Cochin, and Travancore has been eminently favourable to the growth of the Cocoa Nut Tree, and the bountiful system of irrigation has promoted its rapid extension. The district besides being benefited by the neighbourhood of mountains is also much advantaged by proximity to the ocean, and a consequent enjoyment of pure sea breezes; whilst the vicinity of the equator ensures at most times that powerful solar heat without which this tree cannot be reared. No tradition is found in India, as in Ceylon, of its introduction; it has doubtless always existed on some part of this coast, and as man travelled south he became acquainted with the shelter and subsistence it so abundantly provides, and was thereby induced to make settlements in the lowlands, and exert his whole strength for its protection and cultivation. Though the discovery of many of its uses has been reserved for modern times, the Aborigines of the country must intuitively have understood its local advantages, and by endeavouring to widen their influence have been the active agents in transforming the arid plains of the tropics into lands flowing literally with milk and honey.

The wonderful arrangement of nature by which seeds generate from the same point, without regard to the position in which they fall into the ground, is beautifully illustrated in the coconut. The germ is enclosed in a globular shell of intensely hard wood, and from this shell but one exit is possible so tiny that it might be predicted but one nut in a thousand would prosper. By the presence of two unfinished holes contiguous to the actual door, one might imagine kind nature had originally intended to afford the sprouting germ three chances to burst through the walls of its prison house. But the tender little shoot has never yet failed to hit the weak point in the shell, and proceeding through a thin horny integument finds itself in a dense mass of fibres, but these being placed parallel to one another it softly, yet resolutely, forces its way between them and finally issues into the world. If the nut has been cast by the sea on the sandy shore, or, if it has fallen from a tree and been embedded as it lay in the ground, there is a likelihood that the flattened germ-end may be lowest in position; but the shoot no less surely continues progressing a little way into the ground, and then starts upwards at an acute angle, making its appearance above ground as healthy, but not so rapidly, as it would have done had it been spared the circuitous route.

The husk has three sides; one is considerably broader than the other, so that if thrown on a smooth surface the nut will always right itself upon this side as a base in preference to the others. Design is visible in those inequalities, and most planters follow Nature's direction in depositing the nut in the ground; for the germ has by this plant to proceed through a greater thickness of fibre, and thus derives a firmer foundation than if it has burst through the apex, as it does when the nut is planted

vertically. The latter method has this advantage, that the germ can be watered immediately it issues from the husk, and planters north of Calicut generaly prefer it; but those around Cochin consider the horizontal one safer.

It is difficult to conceive that a tree should have its origin from the water and vegetable coating inside the coconut shell, but this is the case. The water gradually thickens as the internal heat increases, and at length coagulates into a soft ball just sufficiently large to fill up the cavity. This ball, or apple, is occasionally to be seen as a curiosity in greengrocers' shops in London; but here of course it is common enough, and from its delicate flavour is generally much esteemed by the natives, though not by Europeans who invariably characterise it as similiar in taste to elder-pith. With sugar and other seasoning a manufacture of it is made by the native cooks just satisfactory to a man after dinner.

The ripest nuts are naturally preferred for reproduction, and the planter generally selects those from middled-aged trees. He clears a piece of land near his house, and immediately before the monsoon plants them in the soil; perhaps as many as twenty together in a small plot of as many feet square. At the end of the monsoon a little pale green shoot appears from each nut, and rapidly develops by daily watering into leaves and stalk. When six months old transplanting becomes necessary, and the young trees are placed at a distance of twenty feet apart on the sea coast, and thirty to thirty-five feet in the interior where the breezes are not so saline or frequent. The shell is still found quite perfect, and remains so many years before it breaks and dissipates in the earth around the roots. There are now about a dozen leaves on the tree each of one piece, but at the end of fourteen months thy divide into a number of sections or leaflets, about one hundred and ten on each side of the stalk. This gradual separation is most interesting; no jagged ends testify to hasty workmanship; but, as if cut with the sharpest razor, the pieces stretch from each other with the most mathematical correctness. At eighteen months old the leaflets are about two inches broad and three feet long and as this is about the dimension of the Palmyra leaflets employed as olas, or books by the natives, the tree is now called "*canak ola.*" At two years old the leaf is of sufficient size to construct a basket capable of containing about twenty-two pounds of grain, and the tree is, therefore, styled "*Cotah-kollah*" or a "*basket.*" At three years old it is known as the "*annah-chawdoo*" or "*elephant's foot,*" in consequence of the large bulbous trunk to that huge extremity. At four years old the wood is first apparent above the ground, and the tree named "*marom cundah*" or "*wood seen.*" At five years old a little horny case or spathe sprouts out between sixth and seventh boughs, bursts on the upper side, and permits the beautiful blossom to issue, on account of which the tree is now named "*chotah-cundah*" or "*blossom seen.*" And the following year it is called "*tangkah-ittoo* or *coconut bearing.*" The tree is now matured and rapidly grows to the height, on an average, of eighty feet. In its prime at about forty-five years old, it then gradually declines until its seventieth year, when the natives cut it down for the sake of the trunk; but if left alone it often attains a century, and at last falls down in rotten decay.

In low grounds likely to be flooded by the monsoon freshes, coconut plants are raised on mounds above the level of the highest rise; and in the subsequent dry weather permanent banks are made by raising earth from one side, and plastering it up tightly against the mound.

* In the interior the patient eyes of the planter are frequently not gladdened by the appearance of the spathe before seven or eight years: and if the tope is unfavourably situated with respect to water and breeze, he has sometimes to wait ten years before he has the satisfaction of witnessing the fall of a ripe nut from a tree of his own rearing.

By this arrangement each bank is divided from that opposite by a narrow canal, which is useful for carrying away the produce. The expense attending the formation of such a plantation is much greater than in grounds where no banks are necessary; but, on the other hand, the trees require no watering as the canals afford sufficient moisture; and the soil, being a mixture of mud and sand, retains the moisture longer during the hot weather than the sand alone can do. Ashes and cow manure put to the trees once in a couple of years fully repay the planter's trouble and outlay by the return of heavy crops; and he cannot take too much care to rid the place of weeds, grasses, and small plants which all require, and derive strength, out of the ground.

It would be vain to attempt a calculation of *all* the blessings man has derived from the coconut tree, but an account of some of the most striking should suffice to gain it a foremost place among the wonders of Nature. It might be well to proceed upwards from the roots as the parts would attract a traveller's observation.

The roots are wonderfully numerous and migratory. In a good soil they are content to radiate from the trunk in a space not wider than the circumference of the many boughs above; but in a poor dry ground they travel onwards in search of more nourishment, and maze themselves with those of neighbouring trees in a most singular manner. With such a hold on the ground, the tree though supporting its greatest weight at the apex remains firmly founded during the fiercest gales: and the winds are seldom successful in uprooting it, though they often by simultaneous attack split the trunk in two. On the coast where the sea is encroaching trees are frequently seen with roots almost entirely exposed, and the salt thus imbibed, as the waves wash them is most beneficial to the fruit; but on some evil day the water carries away the little bank of sand in the rear, and down the tree comes with dreadful violence, crushing any buildings or smaller trees it may fall upon. It is now an interesting subject for observation only, as to raise so great a length with the weight at the topmost end would indeed be a difficult task in this country.

In clearing away old trees for the sake of substituting young ones, much annoyance used to be experienced in extracting their roots, and the further one mined the more hopeless the operation appeared. But a simple and most effective plan has lately been resorted to, both to destroy the roots and benefit the soil at their expense. The trees are cut off about three or four inches from the ground, and the stumps allowed to dry thoroughly for several days, and then set fire to. The trunks gradually smoulder away and the roots slowly follow, whilst with their decay the ground sinks in and merges with their charcoal; so when the process is concluded the planter lays a little fresh earth, salt, and manure, and at once inserts the shoots under the most favourable circumstances.

The native ironmongers collect the roots washed off by the waves of the sea, and after a careful drying employ them as fuel when an intensely hot flame is desired in their work. In many parts the tender green roots are esteemed as a satisfactory substitute for areca-nut, and a decoction of them with ginger, &c., is considered very beneficial in case of fever and diarrhœa. The ashes of the burnt roots and husks yield a large quantity of potash, which is much used for the cure of ulcers, besides a more considerable employment as soap.

The trunk is striped at regular intervals with rings caused by the fall of the old leaves, and as one leaf embraces its circumference and twelve fall in the year, the age of the tree may be roughly estimated by dividing the number of rings by twelve. Naturalists—sitting before the morocco-covered desks in the magnificent reading room of the British Museum—in describing the cocoanut tree, assert

that its age is equal to *half* the number of rings on the trunk; but this is a statement entirely without foundation, and rashly made under the impression that the same rules apply to the growth of palms as of timber trees here and elsewhere. When sixty or seventy years old the wood is very hard and close, admirably adapted for piles of jetties and bridges; but the molluscs and bivalves, so abundant in the rivers of this country, soon extend their researches into the interior, and necessitate the substitution of such piles once every five years. It is much used as rafters and posts in houses and sheds, cut into slabs for fencing paddy fields or plantations, scooped out for water pipes, &c.; and the inhabitants of the Maldives build tight little vessels entirely with planks of this wood, rigging a mast which originally produced cocoanuts at the truck. The outside of the length of the tree gives the best wood; and this carefully seasoned and polished has a very pretty appearance with alternate black and white streaks. It is well known in England as the *porcupine* wood, from its resemblance to boxes made in China and Bombay with porcupine quills.

Tightening the bough's embrace of the trunk is a large piece of closely woven fibre, astonishingly strong and elastic. When the bough has become old enough to bear its own weight, the cloth detaches itself and falls to the ground, whence it is picked up by the natives and used by them for straining various infusions, for snaring birds in the jungle, and, when rolled up tightly, for torches.

It has been well supposed that the arch was suggested to man by his observation of the symmetrical arrangement of the boughs of palms. For there is generally much resemblance in the aisles of a cathedral, the clustered columns, the now subdued now gushing light, the groined roof, to the view down the parellel rows of cocoanut trees. Perhaps few things are more charming in congregation than these trees. With the morning sun gilding the topmost boughs, brightening the verdant gloss of the middle ones, and imparting a golden sherry hue to those beneath, whilst the leaflets are defined against the clear pale blue sky like bayonets in an armoury, or hang glistening like stalactites in an arched cave. The birds sing, or rather warble, incessantly; now one passes overhead with a wild note of delight, now another crosses to the opposite tree to join the chorus of his mates; and the crows with restless activity keep the forest ringing with their hoarse notes. At noon-day the plantation is insufferably hot, the sun's rays penetrate perpendicularly and little effective shade is offered a weary soul; but as evening approaches the avenues, the light fails, a gauzy mistiness creeps over the scene, and the trees at length stand out in bold dark relief against the star resplendent heaven. Insects now take up the song their feathered enemies have dropped; firstly intermittent, as if fearful of discovering their hiding place; they soon acquire confidence; some humming like bees, other chirping like crickets, they unite in maintaining an incessant whirr and buzz throughout a calm night. The moon rises majestically, silvering the motionless leaves and casting those behind into a mysteriously grey shade in a most exquisite manner. In the heated atmosphere of the Palm House at Kew a very good idea may be gained of tropical vegetation. The brigt polished leaflets, the dense green foliage, the cloudy blue or white trunks, and the long bare symmetrically ringed stalks of a jungle are excellently suggested; and if each tree were allowed more space to stretch its boughs, a correct impression might also be derived of the magnificent outline and graceful beauty of the palm tribe.

The trunk is crowned by a bunch of about thirty-five leaves, each on an average twenty feet long and four broad. Looking up from beneath the arrangement of the branches appears as regular as that of the ribs of an umbrella, and as the leaflets do not grow within two feet of the stem (to allow a space for the fruit to hang) the bunches of nuts, and almost all

the boughs can be counted. A most singular deficiency is observable in the shadow cast upon the ground by the boughs: the leaflets are most correctly portrayed, but nothing is to be seen of the *main* stalk. This rises from the under part being rounded, and the leaflets being attached in such a manner as to cast a reflection upon each side, and these rays falling to the earth cross each other, and so the shadow is destroyed.

Twelve leaves would fall naturally from the tree per annum, and the planter seldom cuts away a greater number. On dropping to the ground they are divided down the midrib into two equal sections; these, after three or four days' exposure in the sun are immersed for about forty-eight hours in water to soften, and then plaited by women into mats of the simplest description. Placed one above another upon rude rafters, and roughly tied together with coconut fibre, these mats or *cadjans* are almost universally used in this country for thatching houses, sheds, &c., being nearly impervious to rain and solar rays, and yet retentacious of the heat generated in the erection. These are also manufactured into baskets of all descriptions. The green leaf is excellent food for cows and elephants. The natives on festival days are fond of ornamenting their houses, mosques, or pagodas, with chains of the young white leaflets, and attach them to trees on either side of the roads in a most picturesque manner. The midrib of the branch is employed as a paddle, and even that of the leaflet is much used for bristles, toothpicks, pens, arrows, torches and brooms. The natives of Travancore were at one time subject to a frightful torture with it. Around the thumb longitudinally a number of long pieces of it were placed carefully, bound round tightly with cord, or slips of the leaflet, and when swelling ensued, each piece was drawn out very slowly causing excruciating agony to the wretched victim.

The spathe is about two feet long at maturity when fit for tapping. On cutting it open a number of small white beans are discovered, beautifully arranged in a lump exactly like Egyptian corn; but, upon carefully abstracting the whole from the sheaf they are found collected in clusters round slender branches which now fall over with their burthen in the most graceful manner. After the case has burst, naturally the yellow flowers are thus developed, looking very singular among the surrounding dark green boughs. The pollen of these flowers falls upon and impregnates a few small excrescences at the foot of the stalk, and thus the embryo nut is generated. On an average five nuts are produced from each spathe, and as twelve branches ripen in the year, sixty nuts is the usual crop of an ordinary tree. In the best soil as many as four to even five hundred nut are sometimes plucked from one tree in the year; but as the majority may not produce more than twelve to eighteen, the above calculation is always taken as the yearly supply from each tree in the plantation.

The sweet juice, or sap, of the coconut tree is of inestimable value to the native. The first extraction is usually made when the tree is about eight years old, and the issue, with daily attention, continues regularly from twenty to twenty-five years, though generally young trees are only tapped, as the constant bleeding tends to weaken them after some time. The spathe is bound tightly with the pliant leaflets, and bruised along its whole length three times a day for a fortnight, with a bone mallet. The mallet is nothing more than the thigh bone of a bison, with the marrow cleaned out, and its place supplied by *ghee* which, oozing through, greases the spathe when struck and prevents its bursting.

The Toddy-drawer after tapping proceeds to cut off the apex of the spathe, sticks a little clay on the wound to prevent the juice trickling through too large a channel, covers it with a small earthen pot, returns twice in the day to cut off another slice and tap, and the following morning empties the contents of the chatty into one he wears at his side. As he reduces the length of the spathe, the juice or *Toddy* issues with less readiness, so he generally leaves half of it; and though so much bruising

and bleeding has been undergone, the nuts sometimes burst out and ripen on the stunted stalk. About one quart of a milky liquor is obtained from each tree per diem, without reference to the presence of fruit on any other branches; this the drawer waters into nearly four pints, retailing it in the diluted condition to small farmers of the beverage, who also increase the quantity of fluid; and at length the consumers gulp it down with supreme satisfaction. It is sweet, cool, and refreshing before the sun has risen, and, as a mild purgative, beneficial to Europeans. It is almost generally employed in India for yeast in making bread. The poorest natives often take nothing day after day, but half a shell full of it at noon and a quart of *cunghee* (a very thin rice gruel) in the evening. The nut is now so valuable that the low class of inhabitants cannot afford to buy it for food; and as rice is often beyond their means, they would famish in thousands were it not for the bountiful supply of this extraordinary liquid. As the robbery of nuts from the tree is very easy, stern laws have always existed to punish the theft severely; and by fastening thorns around the trunk at night, and making the inhabitants of the plantation responsible for the fruit, the crops are preserved most successfully; though poor famished creatures are listlessly wandering in the shade of their natural staff of life.

After standing a few hours the toddy begins to ferment, and distillation yields a powerful spirit called *arrack*. Five quarts of toddy will generally yield one of proof spirit; and as that beverage is always plentiful, and the distillation is effected in half a day with the assistance only of a few earthenware pots, arrack is at all times abundant and cheap. It is as transparent and colourless as gin, possesses a seducing flavour, with apparently little danger, which combined with its cost has made it in large request among our European troops in the North; but the stimulus has induced so much cholera, dysentery, and insanity, that Government is now considering its prohibition to this portion at least of our Indian army. The natives have an insatiable thirst for it, and though its effects are not generally so disastrous to them, yet after excessive indulgence their powers are often entirely ruined by the excitement, and life becomes only tolerable by deeper subjection to the passion.

A coarse sugar, called *jaggery*, is manufactured from fresh toddy (collected in pots previously limewashed to prevent fermentation) by boiling it down gradually over a slow fire until a syrup is deposited which poured into cocoanut shells, soon hardens into a brown lumpy substance very sweet but rough to the palate. Some praiseworthy endeavours were made a few years ago to refine it for table use, but though the scheme was relinquished, it is to be hoped some means may yet be discovered to provide South India hereby with a commodity of which it is in great need. Mixed with slaked sea shells jaggery forms a beautiful cement, resisting damp, solar heat, and easily taking a high and lasting polish. Columns, cornices, altars, steps, &c., coated with it are made to resemble pure white marble inimitably. Fortifications built with laterite and this cement resist the action of gunpowder most firmly, and when compelled to yield are blown up in huge solid masses behind which the besieged can still maintain their ground. For facing wharves and quays this plaster is most valuable, and for its durability, facility of moulding, and effect few compositions are superior.

Toddy is further manufactured into *vinegar* by exposing it in vessels for a week in the sun. The acid thus produced is nearly as pungent as any manufactured from infusions of malt, and is somewhat preferable on account of its freedom from all injurious colouring adulterations. With the exception of high caste Hindoos, the natives consume large quantities of it in their curries, and the Jews being compelled to boil sufficient food on Friday afternoon to last them until Saturday evening employ it very

largely in their cookery, and export some six hundred gallons yearly for the use of their Bombay brethren.

The ripe coconut consists of a green husk about two inches thick covering the hard shell which encloses the delicate fruit and water. The natives tear off the husk with singular dexterity, by striking it on a crowbar or pointed piece of wood placed upright in the ground, and pressing it down obliquely with a jerk. The half husks are at once thrown into a tank of water, or into small pits enclosed with bamboos on the seashore, and after three or four months' immersion taken out and dried. They are now thoroughly softened throughout, and easily beaten up with sharp strokes of a mallet into pale yellow fibres about 9 inches long. The *Coir* fibre after being well-dried is either employed in the country, or shipped to Europe and America where it is most extensively used as stuffing for matresses, for which from its elasticity and freedom from insects, it is more admirably suited. The fibre is however of most value when twisted into yarn and rope. The manufacture of yarn, which goes on all over the country as weaving did in England years ago, is simple enough. In a slightly damp condition the fibres are gathered longitudinally between the hands, and twisted into two cords which are plaited together, more fibre added, and so on. An active woman will in a day make as much as fifty yards of yarn of an average size. In twisting the tight qualities, more time and labour is required; and the hands are so much injured by the hard friction that the fine quality is, and (until the application of machinery) must always be scarce and expensive.

Coir yarn is used throughout India in binding planks, lacing buckets, and for every purpose for which we employ twine. Made up into the well-known coir matting it is now almost always to be seen on the floors of churches, lobbies, &c., in England. Coir rope is manufactured with the rough yarn, in the same manner as elsewhere. Hardly a vessel on the ocean sails without either cables or standing rigging of this excellent material, for nothing has yet been found preferable to it in resisting the decaying effect of sea water. Its elasticity, lightness and trifling cost are other great considerations.

The young nuts are never plucked except for food. The water is then a delicious beverage, and the tender kernel with a little sugar an agreeable and wholesome diet, in great request during the hot months and consumed in large quantities on board most homeward-bound vessels. The natives besides introducing them into their curries eat them uncooked or made into puddings with rice. These puddings are boiled most carefully in a piece of bamboo about one foot long, and when done to the sable damsel's taste are displayed in tempting array between rows of shells filled with the same delicacy. Since the coconut has been in request for its oil, the natives have ceased to regard it as their chief article of food, for its value quite prevents their indulgence in even one a day. They seem all very fond of it, which doubtless was not the case when it could be had for asking.

The *milk* of the coconut is not the liquid enclosed in the interior, but the juicy moisture contained in the flesh of the undried nut. It is obtained by grating the kernel, moistening it slightly, and then squeezing the mass tightly in a cloth, when a white milk exudes, very agreeable to drink if diluted in a little water. The native employ this almost universally in manufacturing their own and their master's curry, besides making with it and powdered rice some delicate cakes called *appths*, which almost always appear on the breakfast table. The milk boiled down slowly changes into a rich oil, also largely used in cookery.

The shell of the ripe nut is broken with one blow of a heavy iron knife into two equal portions which are exposed in the sun for three or four days to dry up the kernel, and render its extraction easy. For firewood, cups, plates, ladles, and little utensils the native is satisfied with these half shells. The dried kernels are placed in a mill, and their weight nearly expressed of a yellowish transparent oil. The mill is simple

enough; in a mortar, constructed out of the trunk of a tree, a pestle is drawn round and round by two oxen, and crushes any kernels it may meet. The man attending to it, feeds the mill slowly until the pit is filled with oil and cake: the oxen are then halted, and a cloth frequently soaked into the oil, and squeezed into a pot by his side until the whole is extracted. The cake is of some value for fattening cows, pigs, poultry, &c., or as manure. The oil is either sold at once to collectors in the country, or brought by the manufacturer himself to Cochin and entrusted to the dealer, who either realises it on commission, or on his own account. An interprising firm in Cochin lately applied steam in its extraction, adopting the expedient of turning the mortar round a stationary pestle and draining off the oil into little tubs below.

Coconut oil is burnt from the Himalayas to Cape Comorin, in every place, church, mosque, and hovel, at christenings, marriages and burials, either in brazen lamps, glittering chandeliers, porcelain vases, earthen pots, or coconut shells. Since Price's Candle Co. introduced it into their manufactory, it has found its way (as the chief constituent of the composite candle) into every dwelling in England: and more or less penetrated into France, Germany, the United States, and Australia. The astonishing demand that has sprung up in the last few years necessarily enhanced its cost, whilst the production lagged behind consumption; and in India an important addition has in consequence been made to the housekeeping expenses. Indeed plans are being matured for the introduction of gas into Calcutta, as the importation of coal from England, Australia, or New Zealand, and the cost of manufacture would (provided it were generally consumed) afford the inhabitants a much cheaper light than that of oil. But if gas be oppressive in sitting rooms at home, it will be insufferably so in India, where one so urgently requires a cool and untainted atmosphere; and though oil may with advantage be expelled from the streets, there seems little chance of its losing importance in private life.

The natives employ this common oil in making their own dishes and unless looked after act upon an idea that it is the best seasoning for the sahib's food. They anoint their hair with it, and when able to afford the expense, their bodies also. This state is extremely disagreeable to a newcomer and especially so in Ceylon, where the flavour of food is precisely the same as the scent of the attendant, and the odour of the flaring lamp? For protecting the skin from dust, keeping the pores well upon, promoting coolness, and for a remedy against many external diseases it is most valuable. It is often taken internally as a medicine, and a general impression prevails that it might be administered in cases of consumption with most of the advantages attributed to cod liver oil.

There are many things in vegetation which without much study peculiarly strike the observer with feelings of intense admiration and reverence for the Creator's bountiful design, and in proportion as we discover their uses to ourselves we are induced to regard them as superlatively wonderful. Nothing can more induce such thoughts than the coconut palm, whether considered in respect to its agency in fertilizing the sandy coasts of the tropics, to its astonishing growth and perfect symmetry, or to its abundant yield of

> "clothing, meat, trencher, drink, and can,
> Boat, cable, sail, mast, needle, all in one.

COCOS NUCIFERA.

(From the *Treasury of Botany.*)

The well-known coconut tree is the type of this genus of palms, to which, in addition, about a dozen other species belong. They mostly form tall graceful trees, and the majority of them are natives of the tropical regions of America, one only; the common coconut, being found in Asia or Africa. Their leaves are very large and pinnate. Their

flowers are of separate sexes produced on the same spike, both having a calyx, consisting of three sepals, and a corolla of three petals, the males containing six stamens united at the base, and the females an egg-shaped ovary, with a short style and three stigmas, and sometimes six barren stamens. The fruit is either elliptical, or egg-shaped and three-sided, and contains a single seed enclosed in a hard bony shell, which has three round holes at its base, and is surrounded by a dry fibrous husk.

The Coconut Palm, *C. nucifera*, is now so extensively cultivated throughout the tropics, that it is impossible to ascertain its native country: there can be no doubt, however, that it is indigenous to some part of Asia probably Southern India. It exists in vast quantities on the Malabar and Coromandel coasts, and adjacent islands, growing in the greatest luxuriance upon sandy or rocky sea-shores, and evidently preferring the vicinity of the sea, although it sometimes occurs a considerable distance inland. It is also common in Africa, America and the West Indies. Its extensive geographical distribution is accounted for by the fact of the tree growing in such close proximity to the sea, that the ripe fruits, falling on the beach, are washed away by the waves, and afterwards cast upon some far-distant shores, where they readily vegetate. It is in this way that the coral islands of the Indian Ocean have become covered with these palms. It is also worthy of remark that the triangular form of the fruit facilitates its progress through the waves.

The Coconut Palm has a cylindrical trunk, sometimes as much as two feet in diameter, and rising to the height of sixty or one hundred feet, its outside being marked with scars, indicating the places from which leaves have fallen away. It is surmounted by a crown of gracefully curved feathery or pinnate leaves, each of which is from eighteen to twenty feet in length, and composed of a strong, tough, central foot-stalk, with numerous narrow long and sharp-pointed leaflets arranged along both sides of it, giving the entire leaf the appearance of a gigantic feather; the base of the stalk spreads out so as to clasp the stem, and is surrounded by a kind of fibrous net-work of a light-brown colour. The flowers are arranged on branching spikes five or six feet long, and enclosed in a strong tough pointed sheath (spathe), which splits open on the under-side, displaying the delicately white but inconspicuous flowers. They are succeeded by branches containing from twelve to twenty fruits, each of which is about a foot long by six or eight inches wide of a three-sided form, and covered by a thick fibrous rind or husk, enclosing a single seed contained in a hard shell, which is what is commonly called the Coconut in this country.

The uses of this palm are so numerous that space will only allow us to give a brief outline of them. In this country we know comparatively little of its value. It is true that we are indebted to it for several very useful articles, such as coconut fibre, coconut oil, and the coconuts themselves; but they are all articles that we might contrive to do without. In tropical countries, however, such as Southern India and the adjacent islands, the case is very different; there the Coconut Palm furnishes the chief necessaries of life, and its culture and the preparation of its various products afford employment to a large part of the population. Every part of the tree is put to some useful purpose. The outside rind or husk of the fruit yields the fibre from which the well-known coconut matting is manufactured. In order to obtain it, the husks are soaked in salt water for six or twelve months, when the fibre is easily separated by beating, and is made up into a coarse kind of yarn called *coir*. In 1858 we imported 81,138 cwt. of this fibre. Besides its use for matting, it is extensively employed in the manufacture of cordage, being greatly valued for ships' cables, and although these cables are rough to handle and not so neat-looking as those made of hemp, their greater elasticity renders them superior for some purposes. Other articles of minor importance are now made of this fibre, such as clothes' and other brushes, brooms, hats, &c.; and when cured and dyed it is used for stuffing cushions, mattresses, &c., as a substitute for horse-hair.

The next important product of the fruit is the oil procured by boiling and pressing the white kernel of the nut (albumen). It is liquid at the ordinary temperature in tropical countries, and while fresh is used in cookery; but in this country it is semi-solid and has generally a somewhat rancid smell and taste. By pressure it is separated into two parts—one, called stearine, is solid, and is used in the manufacture of stearine candles; the other being liquid is burned in lamps. As an article of food the kernel is of great importance to the inhabitants of the tropics. In the Laccadives it forms the chief food, each person consuming four nuts per day, and the fluid commonly called milk, which it contains, affords them an agreeable beverage. While young they yield a delicious substance resembling blancmange. The hard shells of the nut are made into spoons, drinking cups, lamps, &c.; reduced to charcoal and pulverised they afford an excellent tooth-power, and very good lamp-black is made from them.

Amongst other products of this palm may be mentioned 'toddy' which is obtained by the same process as that described under *Borassus flabelliformis*. When fermented it is intoxicating, and strong arrack is distilled from it, besides which it yields vinegar and 'jaggery' or sugar.

The leaves are greatly used for thatching houses, for plating into mats, baskets, hats, and similar articles; and from strips of the hard footstalk very neat combs for the hair are made. The unexpanded leaves cut out of the heart of the tree are used in the same way that we use cabbages. The brown fibrous network from the base of the leaves is substituted for sieves, and also made into fishermen's garments, and the extremely hard wood obtained from the outer portion of the trunk is used in the construction of both houses and their furniture. In this country, under the name of Porcupine wood, it is made into work-boxes, and other fancy articles. Finally, we may mention that the natives attributive various medicinal qualities to this palm. The flowers they employ as an astrigent, the roots as a febrifuge, the milk in opthalmia, &c.

Few of the other species of this genus present particular features of interest. *C. butyracea*, a native of New Grenada, yields toddy, but the manner of extracting it is very different to the process employed in Eastern countries. The tree is cut down, and a long cavity excavated in its trunk near the top; in three days' time this cavity is found to be full of toddy, which, it must be borne in mind, is the sap of the tree. Its seeds yield a semi-solid oil. *C. coronata*, a small Brazilian species not more than thirty feet high, has a pithy substance in the interior of its stem which is used as food; seeds also yield oil. [A.S.]

PALMS IN "CEYLON AND ITS CAPABILITIES."

By J. W. Bennett, F.L.S., 1843.

1.

Conflicting Descriptions of the Palms of Ceylon—Extraordinary Accounts for the process of Sura or Toddy Drawing—Classification and Description of the Coconut Tree—Process of Toddy Drawing, from Personal Observation—Sinnet for Sailor's Hats—Toddy, or Palm Wine Varieties and Domestic Uses of the Cocos nucifera—Arrack—Oil—Vinegar—Jaggery—Native Method of Planting it, and their Superstition about Salt—Uses of the Fronds—Coconut Timber Adhesive Properties of the Water of the Green Coconut The Hiromane—Average Produce of a Coconut Tree—Uses of the Shells Medicinal Oil from the Bark—Medicinal Properties of the Root, Leaves, and Flowers—Extraordinary Notions about the Superabundance of the Coconut Palm, and Facility of Planting it—Coconut Oil Used in the Manufacture of Soap and Candles—Suggestions for extending the Culture of the Coconut Palm in the British West Indian and West African Colonies.

So many conflicting and erroneous accounts have been given of the palms of Ceylon, in travels and extracts from the travels of various

writers, that if I were not satisfied to the contrary, I might be disposed to think the authors endeavoured to mislead, instead of inform, their readers; and if the former will be governed by *native* statements only, instead of witnessing the processes which they pretend to describe, one cannot expect that the latter, how much soever they may be amused, will be enlightened by accounts at variance with facts. The subjoined notes (a) from the works of authors who have obtained general credence for the correctness of their representations, are (as all who have really witnessed the tedious process of preparing the coconut tree for the production of toddy will admit) absolute illusions.

Let it be supposed, for instance, that a planter in the West Indies, (where toddy drawing was, some few years ago, and probably continues to be, entirely unknown,) being desirous of testing these plans, adopted either one or all of them; and let his disappointment be imagined, when, anxiously anticipating the assured morning's draught of the "Palm wine of the poets," he found it altogether Entopian! and if either of these incisive measures had been resorted to, and the pot hung up at the times these accounts were written, the authors would have waited a long time for their toddy; for it would not, even yet, after an interval of so many years, have begun to distil. I will, therefore, briefly describe the various natural properties and domestic usefulness of this splendid palm, from my own personal observation. The Coconut palm (*Cocos nucifera*, L., and *Polyalt* of the Sinhalese, Class XXI. *Monœcia*, Order VI. *Hexandria*, Natural Order *Palmæ*,) delights in a sandy soil, and the nearer to the margin of the sea, the quicker its growth, and more abundant its produce. It requires little or no care, beyond being well fenced from the inroads of cattle, for, fanned by the winds of the Indian ocean, it gains fecundity by exposure; and although its general height is from sixty to eighty feet it is not uncommon for it to exceed a hundred. Its diameter, at the base, is from two or three feet; and the root, which is composed of strong flexible fibres, about the thickness of a small rattan cane (*Calamus Rotang*, L.), spreads in a circle; and of these, some run to a great depth, and others creep along the surface of the soil. One may imagine a beautiful and verdant circle, formed of feathery fronds, from fourteen to sixteen feet in length, radiating from a common centre at the top of a tapering stem eighty feet in height, and that will afford some idea of the magnificence of the coconut palm.

The fronds are supported at the base by diagonal horizontal layers of strong elastic fibres, capable of sustaining great weight, and so closely united as to form, when gently stretched, an excellent substitute for a hair sieve for straining liquids. This fibrous support lies in *laminæ* between the branches, which it envelopes, as well as the incipient ones even to their rudiments, or what is commonly called the *cabbage*, and seems providentially adapted for the security of the passing traveller

(a) "Toddy is the juice running from an incision made in the stem of the leaves; and constitutes a very pleasant beverage when first gathered in."—*Statham's Indian Recollections*, page 29.

"A pot sufficient to hold two quarts is fixed to a shoot where an incision is made in the evening, and is brought down full at sunrise in the morning."—*Cordiner's Ceylon*, vol. i., page 352.

"A small incision being made, there oozes in gentle drops a cool pleasant liquor, called *taree* or *toddy*, the palm wine of the poets."—*Forbes's Oriental Memoirs*, page 24.

"Toddy is procured by incision. It is only necessary to make a slit in the top of the tree, where the leaves shoot up, with a knife over night, and suspend a chatty, or earthen pot, from the branches so as to receive the juice, which immediately begins to distil, and continues to do so till next morning, when the pot is removed."—*Percival's Ceylon*.

"Between the cabbage-like shoot and the leaves, there spring several buds, from which, on making an incision, there distils a juice differing little from water in color or consistence. This liquor is sold in the bazaars by the natives under the name of toddy."—*Tennant's Indian Recreations*, vol. ii., page 283.

See also Kerr's Voyages, vol. vii., p. 176; and Pennant's Hindustan, vol. i., p. 139.

from the constant danger that would otherwise attend him, whilst traversing the coconut topes, from the sudden falling of decayed branches, which its very firm adhesion to the trunk prevents; but it is not made into gunny bags, (*Gungesaaken* of the Dutch,) as some authors have stated, and is merely used for straining toddy and other liquids, and for kindling fires. During the many years that I resided in Ceylon, I never heard of but one fatal accident from the falling of a coconut; a remarkable circumstance, when one considers the many thousands of people constantly passing and repassing through the topes (*b*).

Trees, intended for toddy drawing, are prevented from producing fruit by the following process. The toddy drawer first ties the spathe in three places, with strips of the tough white *pinnæ (c)* of the young fronds; which latter shoot perpendicularly at first, and are then of a beautiful white, but soon change to a straw color; these are concave towards the heart of the crest, and when they are successively forced from their position by new fronds, they gradually expand their pinnated leaves, and ultimately become horizontal. The old fronds have a strong mid-rib, with the footstalks nearest the tree proportionally thick: these embrace the stem, and as they gradually fall off, after hanging for weeks together by their fibrous support, or are pulled down for fuel, torches *(d)* and fences, they leave successive and very visible scars.

The purpose of tying the spathe is to prevent its expansion; it is then cut transversely, the extent of about two inches from the point, and beaten with an ebony or iron-wood baton, by the toddy drawer, for five or six mornings and evenings successively. The next operation is to remove a portion of the footstalk of the spathe, so as to admit of its depression, for the juice to flow freely, and it is kept in that position by attaching it to an inferior branch; in the course of five or six days, the toddy drawer suspends a calabash, or earthern pot, called a *chatty*, from the decapitated spathe so as to receive the juice as it exudes from the flower, and this he repeats every morning and evening, taking off a slice of the flower as occasion requires, whilst any part of it remains. This delicious liquid, combining a pleasant but slight degree of sweetness with still less degree of acidity when fresh and of peculiar flavour, is called by us toddy; *Ra*, by the Sinhalese; and *Suri or Sura (e)*, (which means palm wine,) by the Hindoos and Hindo-Portugese; and, being esteemed a gentle aperient, it is very often resorted to at the earliest peep of dawn, by the *bon-vivant*, by way of removing the unpleasant effects of more potent libations over night.

There are five varieties of this palm in Ceylon, and the grounds adjoining the Buddha temples generally contain the best specimens of the indigenous species. The priests readily afford strangers every information, but only upon inquiry, for their diffidence, which arises from the dread of

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(*b*) An Indian name for groves. In Bengal, mango plantations are called *topes*, as well as those of the coconut tree; but where groves of palms are reserved for toddy drawing, they are called *toddy topes*.

(*c*) These are in general request by sailors in India for making hats. Jack first reduces the pinnæ into very narrow strips, then plats them into what he calls *sinnet*, and, with a needle and thread, soon forms a good but heavy substitute for a chip hat; for it wears remarkably well, and being cooler than one of glazed leather, is better for inter-tropical service. Of the mid-rib (*costa*) the natives make neat whisks and bird cages.

(*d*) *Chulos*, and, (Anglicé,) *Chules*. These the natives make, by laying down the pinnæ horizontally from the footstalk towards the point; but they leave one or two, at certain instances, in their natural position, for the purpose of tying the others round the mid-rib, or rather, the longitudinal section of it for each frond makes two chules.

(*e*) "The word *Sura* in Sanskrit signifies both wine and true wealth; hence in the first *Chand* of the *Ramayan* of *Valmic*, it is expressly said that the *Devatas* having received the *Sura*, acquired the title of *Suras*, and the *Daityas* that of *Asura*, from not having received it. The *Veda* is represented as that wine and true wealth; and the *Devatas* as enjoying it, in a superior degree, being termed as *Suras*, the prince, or supreme leader of the *Sura*, became, in the Grecian deity Baccaus, (by a confined translation of the word,) the god of wine and drunkards."—*Asiatic Researches*, vol. viii., page 50.

being considered obtrusive, does not proceed from disinclination to gratify the curiosity of the European visitor; and without *asking* for information when required, one many remain all one's life time in Ceylon and know no more of the varieties of the coconut palm than casual observation might suggest, from the mere circumstance of the difference in point of color of the nuts, from the *Kurroomba*, or water coconut, to that which approaches, or has attained maturity. The peculiar shape and bright orange colour of the *King coconut* cannot fail to attract observation, but it is scarcely even to be seen in the bazaars. It is occasionally presented by the priests or headmen, by way of compliment, to Europeans.

The next in beauty is of an orange color, but not of the beautiful pear shape of the king coconut. The third is of a pale yellow, rather cordiform, and the fleshy substance of its husk, which is between the epidermis and the nut, is edible in its green state. The fourth is the common coconut which is abundantly imported into this country from the West Indies: and the fifth is a sort of Maldive (*f*), or dwarf coconut, about the size of a duck's egg; this is esteemed as a rarity. I have remarked the coconut palm, in its various stages, in many countries; namely, the Azores, West Indies, Mauritius, Coast of Coromandel, Bengal, Penang, Malacca, Moluccas, Banda Islands, Celebes, and Timor; but I never saw it attain the height that it does in Ceylon. The finest arrack in the world is distilled by the Sinhalese from the fermenting toddy, (which, owing to the rapidity of that process, becomes an intoxicating beverage in the course of a few hours,) and not from sweet toddy, as some travellers have erroneously asserted. One hundred gallons produce, by the simple chemical process of the Sinhalese, twenty-five of arrack (*g*)—*Polwakere* which, when very new, is injurious to the constitution, but gradually acquires wholesomeness by age. Toddy is also used by bread bakers for the purpose of yeast.

Pine apples, steeped in arrack, impart a delicious flavor, and reduce its strength to that of a liqueur, unrivalled for making nectarial punch, or *Puntjee* of the Hindus, meaning five:—thus our compound of sugar, lime-juice, spirit, water, and lemon-peel, derives its English name from a Hindu numeral. Lamp oil is made from the kernel of the ripe coconut, after it has been exposed to the sun on mats until it has become rancid and discolored, (in which state the natives call it *Kopperah,*) by means of a simple press turned by bullocks; and oil for culinary purposes, by boiling the fresh pulp, and skimming it as it rises. The former is now made into candles and soap, and the oil-cake, or *poonac*, is used for feeding cattle and poultry. Vinegar is made by putting toddy, drawn in dry weather, into jars, and keeping them closely covered, but exposed to the sun, for a month; the toddy is then strained, and replaced in the same jars, with little bird pepper (*Capsicum fartescens*, L.), a small piece of the red Ghorkah *Cambogia gutta*), and of Moringa pod (*Hyperanthera moringa*), the jars are then laid in the earth for a month or five weeks, and thus a very excellent vinegar is produced.

Jaggery, a sort of sugar, is made by suspending a clean and dry calabash or chatty, instead of one in common use for toddy drawing, and containing some chips of the bark of the *Shorea robusta*, (*Halgas* of the Sinhalese,) which will cause the toddy to become sweet. Eight gallons of it boiled over a slow fire, yield two gallons of syrup, called in Sinhalese *Penni*; which, being again boiled, produces a coarse brown sugar, called *Jaggery*; this is formed into cakes in bottoms of coconut shells, by way of moulds; which, having been enveloped in pieces of dried plantain leaf, are hardened, and preserved from humidity by being suspended where smoke has free access to them. A coconut tree,

(*f*) So called, because the Maldivian boats which visit the island bring a few extremely small nuts as curiosities.

(*g*) Batavian arrack is distilled from rice.

planted near the sea, generally blossoms in the fourth or fifth year; but in elevated situations of the interior, six or seven years may be considered the average period; and from that time to upwards of sixty years, this most prolific palm will continue to produce fruit in abundance, unless the tree be devoted entirely to the toddy-drawer, in which case it produces no fruit. The maturity of coconuts reserved for planting, is indicated by the brown colour of the husk; they are then plucked, and, having been laid aside for a few days, are ranged in rows, and, partly covered with earth; or, as in many parts of the country, suspended from the branches of trees until vegetation has commenced. In about three months, more or less, the plant will have appeared, and, in less than five months from that time, will have attained the height of sixteen or eighteen inches, and have thrown out three or four foliaceous fronds. The best time for transplating is during the rainy season, when the plants receive that abundant nourishment which their nature requires.

The Sinhalose are so extremely superstitious, that they invariably throw a little salt into the holes, before they place the coconut plants in them; and they observe great regularity in forming their topes, by making holes for the plants in parallel lines, from twenty to twenty-four feet apart, about three feet deep, of the same diameter at the top, and in the shape of inverted cones, for the purpose of collecting the necessary moisture. If the salt were omitted, they would not expect the plant to flourish. The green fronds split, and their pinnated leaves interwoven, make covers for plants, baskets, and thatch; (*h*) and, when burnt, produce a superior alkali. The young *pinu* which are white and tough, make beautiful mats, baskets, and boxes for ladies' work. The stem is at first of a very spongy nature, and full of tough perpendicular and ligneous fibres; and until it is about twenty years old, is applicable only to the purposes of gutters, water pipes, and fences; but when it becomes old, it is fit for rafters, shingles, ornamental cabinet work, rice pounders, walking sticks, and for building country vessels, called *Dhonies (i)*. The water of the green coconut is a delicious drink, if it be plucked before sunrise; it is also used by house-plasterers, for its adhesive quality, in mixing their white and colored washes, and, conjointly with jaggery and shell-lime, for stucco. The pulp of the young coconut is an admirable vegetable *Blancmange*; and the kernel of the seed coconut, after vegetation has commenced, is among the delicacies of a Sinhalese dessert. It is spongy, but pleasant to the taste, and greatly esteemed by the natives. The expressed juice of the pulp of the ripe nut is properly the milk, and is obtained by first rasping it with an instrument called *Hiramane (j)*, then soaking it in water and pressing it through a cloth, when it forms an ingredient in all good curries. The cabbage is delicious, whether fricaseed or pickled, or in its raw state when it is as sweet and crisp as the Catappa almond (*Terminalia Catappa* L.)

A bunch of coconuts seldom exceeds fifteen or twenty good ones; and from trees growing in sandy situations, the fruit is gathered four or five times a year. The external husk, after having been soaked in water for a certain period, is beaten out into a fibre called *Koir* or *Koya*, of which, yarn, ropes, cables, brooms, plasterers' brushes, bed and sofa mattresses, and bags are manufactured. Coconut shells are made into cups, basins, lamps, sportsmen's liquor flasks, ladles, skim-

(*h*) Called by the natives, *Cajan*. (*i*) From 80 to 200 tons burthen.

(*j*) The *Hiramane* is the best kind of grater that can be employed to reduce the kernel for culinary purposes, because it obviates the necessity of breaking the nut-shell in pieces, or the previous removal of the kernel from it, which, in its ripe state, is no very easy matter. It consists of a circle of notched iron fastened to the end of a stout piece of wood, cut in a peculiar shape, which immemorial custom has induced the Sinhalese to consider the most convenient for this domestic purpose; and considered by Europeans to resemble a *boot jack*, but why, I have yet to learn.

mers, spoons, lamphlack, and charcoal; which latter, when pulverized, forms an excellent dentifrice (*k*). A powerful oil is extracted from the bark of the coconut tree, which is employed as a liniment in cutaneous diseases, and considered by the Sinhalese doctors eminently efficacious, provided that, in such cases a free use of the green coconut, as the principal article of diet, be strictly adhered to: and an ointment is prepared from the kernel, which is a certain cure for the ring-worm in children.

The root is considered by the native doctors so efficacious in intermittent and remittent fever, that it is almost invariably employed by them. Small pieces of it are boiled with dried ginger and jaggery, and the decoction is given to the patient at regular intervals. The same decoction, when used as a gargle, is mixed with the oil of the nut, freshly made, and generally affords considerable relief to the patient in cases where pustules have formed in the mouth or glands of the throat.

In hemorrhoids, the expressed juice of the leaves, mixed with fresh oil of the nut, and taken internally, is considered a sovereign remedy; and in ophthalmic complaints the external application of the expressed juice of the nut, mixed with new milk from the cow or goat, mitigates, if it does not entirely remove, inflammation.

The juice of the flower is of so astringent a nature, that it has the same effect as a solution of alum upon the inside of the mouth; this, mixed with new milk, and taken in small quantities, not exceeding a wine-glass-full but at regular periods, affords almost immediate temporary relief, and, if persevered in, effectual cure, in that most debilitating of diseases in tropical climates, *Lues Gonorrhœa*. The shade of the coconut tree is wholesome; for wherever there are coconut topes, very little underwood is found. An odd notion has long prevailed, that if all the coconut trees in Ceylon were cut down, the natives would be obliged to cultivate the rice more extensively, and that it would operate as a general blessing!! To me it appears a subject of regret, that the many virtues of this invaluable palm, apparently bestowed by the hands of a beneficent Providence, for the use and happiness of the natives of tropical climates, are not more universally known and encouraged throughout the British West India Islands. Those whose duties may have called them, as in my own case, to both countries, cannot have failed to remark the apparently degenerated state of the coconut tree of the West Indies in comparison with that of the East (*l*).

The facility of planting the coconut palm the small portion of care requisite for its growth and preservation,—the multiplied benefits which in its maturity it bestows man,—all tend to render it an object of peculiar regard to those who are the guardians, deputed by the Giver of all good, of the labourer of the tropics.

The Sinhalese are very remarkable for their luxuriant and beautiful hair, and attribute it to the use of coconut oil, which, in a perfumed state, is also employed by Europeans; but it is only by habitual use that its virtues can be sufficiently ascertained to insure its general adoption as a promoter and preserver of the hair, unless its natural properties are destroyed by adulteration: and as steam and other English oil-mills are now used, and the demand for coconut oil has generally increased, since its employment in the manufacture of candles and soap, it may be anticipated, that from the recent improvement of the quality of the coconut oil

(*k*) See page 103, Bennett's Ceylon for the Sinhalese musical instrument, the *vinah*.

(*l*) If the reader have not previously read "A Treatise upon 'the Coconut Palm, by a Fellow of the Linnæan and Horticultural Societies," published in the year 1830, and a second edition of it, in my own name, in 1836, it will afford him some amusement to compare the former with the second volume of "Wanderings in New South Wales, Batavia Pedir Coast, Singapore, and China by George Bennett, Esq., F.L.S., and Fellow of the Royal College of Surgeons," (published by Mr. Bentley in 1834,) pages 297 to 335 inclusively.

for table use, by its being rendered free from smoke, its importation will continue in an increasing ratio; and, consequently, too much attention and encouragement cannot be given to a more extensive cultivation of this invaluable palm, not only at Ceylon, but throughout our West Indian and West African colonies.

Independently of the general consumption of the produce of the coconut palm by the native inhabitants and its extensive employment in the most domestic economy of Europeans, it finds a ready market for exportation; and the manufactue of coir yarn, ropes and cables, oil, vinegar, arrack, jaggery, and cajans for thatching bungalows and native houses affords employment to a considerable portion of the Sinhalese and Malabar population.

II.

The Areka Palm and its Linnæan Classification—Flower and Fruit used for Ornamenting Temporary Buildings for Festivals—Arekanut Anti-scorbutic—Spathe and its Uses—Terra Japonica—Properties of the Arekanut as a Dye—Suggestions for Condensing the Dye—Heat Generated by the Nuts—Barter through the Agency of Buddhist Priests—Wood excellent for Bows—Palmyra (Borassus flabelliformis, L.) common in the Northern and Eastern Provinces—Buddhist Priests and their Fans—Native Books—Palm Oil—Kellingo Palmyra Toddy and Jaggery—Timber and its principal Uses—Sagar Palm (Caryota urens, L.)—Kitul Fishing Rods—Sago—Elephant Bows and Snares or Nooses—Kitul Toddy and Jaggery—Hookahs—Calabashes—Sugar Palm chiefly cultivated in the Southern Province—Talipot Tree (Corypha umbraculifera, L., and Licuala spinosa of Thunberg)—Its Classification—Talipot Leaf—Its Uses—Conflicting Accounts of the Report caused by the Bursting of the Spathe of the Talipot Tree—Mahole—Talipot Sago—Talipot Palm at Colombo—Privileges of the Priests of Buddha—M. de la Loubere's Notice of the use of the Talipot Fan by the Priests of Siam—Talipot Plants sent to England by the Author—Tavelam Tents—Palms from Mauritius introduced into Ceylon—Phœnix sylvestris, L.—Dwarf Palm.

In a commercial point of view, the Areka palm (*Areka catechu*, L., Class *Monœcia*, Order *Monadelphia*, Natural Order *Palmæ*; *Puak-gaha* of the Sinhalese, *Faufel* of Bauhine, and *Pinanga* of Rumphius) is next in value to the cocount tree. The flower, which, like that of coconut palm, is white, is used conjointly with its beautiful drupes, and the flower and fruit of the coconut tree, and the wild flowers and moss (*Lycopodium zeylanicum*) with which the cinnamon gardens abound, in ornamenting temporary buildings for ball and other festivities.

This palm so greatly resembles the cabbage palm (*Areca oleracea*, L.) of the West Indies, that, upon a cursory view, it is scarcely to be distinguished from the latter except by its drupes. The heart of the crest of the *Areca catechu* is also edible; but it is both inferior to that of the cabbage and coconut palms. The drupes are about the size of a hen's egg, (*m*) with a smooth epidermis of a bright gold or orange colour, occasionally speckled with brown; these grow in clusters, like coconuts in miniature, but at the very base of the verdant crest, instead of between the fronds, as in the coconut palm. The average annual produce is from 280 to 300 nuts.

The nut forms a principal ingredient in the betel masticatory, so general throughout India and the Eastern Archipelago, where it is called *Paan* or *Pawn*, and is the first thing offered by way of compliment by natives of all classes. It is considered an anti-scorbutic for the teeth and gums, and to give the breath an aromatic odour; but its habitual use imparts an appearance of bleeding at the mouth, which is particularly disgusting in women. The pulverized charcoal of the nut forms an excellent dentifrice.

(*m*) Described in the *Hortus Botanicus Americanus* as of the size of a *coconut*!!

The fronds are more bushy in foliage than those of the coconut tree, and about half their length: they have also a strong mid-rib, but the leaflets are *folded back*, and being more irregular in shape, and thicker than those of the coconut palm, cannot be interwoven into *Cajans*. The base of the crest, to the height of three feet, is enveloped in a sort of spathe, which the Sinhalese called *puakpatta*; this being extremely tough and elastic, is of great utility to the natives for domestic purposes particularly for carrying milk and oil, and their curry and rice, when travelling; but where the sugar palm (*Caryota urens*, L.,) abounds, it is principally in request for the purpose of holding the *Kitul Pennì*, or sweet syrup, and will retain its original elasticity for many years.

I have heard it asserted, that the extract of the arekanut is the *Terra Japonica* of commerce, and if a few of the nuts are boiled in water with a little chunam, the decoction has both the taste and odour of that drug; but if this be the case, its presents name is greatly misapplied. The properties of the arekanut, as a dye, are well-known in Scotland; it is of a peculiar red, and cannot be mistaken by any one accustomed to the other. I should conceive it practicable to condense the dye, so as to save a great deal in freight, instead of importing the nuts; and strong objections to their exportations to any great distance arises from the excessive heat which is generated by their stowage in bulk; this is perceptible even whilst lying in heaps tar a few days before they are shipped,

The Ceylon areka tree is famous for the superior quality of its nut, which was always a great article of barter between the Kandyan inhabitants of Saffragam, and Barberyn, viâ Kalutara, long before our occupation of the interior. This traffic was chiefly carried on through the agency and connivance of the Buddhist priests, who allowed depôts of nuts to be formed at the various *Pansalas* (*n*) on each side of the Kalu-ganga, from whence they were conveyed away, in *Pardie* (*o*) boats, to the sea coast. The tree itself is beautiful, and delights in a sandy soil. The stem is slender, and, with occasional exceptions, straight as an arrow to the height of seventy or eighty feet. Its circumference varies little throughout its length, seldom exceeding two feet at the base from which to the crest, the wood is as tough as whalebone, and the best in the world for bows and pingoes. There is a wild species of this palm (*Areca sylvestris*), which the Sinhalese call *Lenateri gaha*.

The third palm, in point of value for its domestic properties, is the fan palm, or palmyra (*Borassus flabelliformis*, L.), class XXII. Dicœcia, and order VI. Hexandria. Sinhalese call it *Talgaha*. Linnæus describes the male tree by the Malabar name of *Ampana* and the female tree by that of *Carim-pana*. Male flower, *calyx*; universal *spathe*, compound; *spadix* amentaceous, imbricated; *corol* tree-parted; *petals* egg'd concave; *stamens* filaments six, thickish, anthers thicker, striated.- Female flower, *calyx*; *spathe* and *spadix* as in the male; *corol* three-parted; *petals* roundish, small permanent; *pistil*, germ roundish, styles three, small, stigmas simple; *pericarp*, drupe roundish, obtuse, rigid, one cell'd; *seeds* three, rather egg'd, compressed, distinct, filamentous. Like all the other palms, the fronds of the palmyra grow on the top of the tree only; but as these are cut down, or fall off, they leave their *vestigia* much more distinct than either of the other palms, and the bark is consequently so much rougher, that the tree may be ascended with less difficulty, by inexpert climbers, than either the coconut, areka, or sugar palms. The spathe resembles that of the *Areca Catechu* in toughness and elasticity, and is used by the natives for similar purposes. This tree is more common in the Northern and Eastern Provinces than in any other part of the island; and those that I have seen seldom exceeded thirty or forty feet in height. The fronds are fan-leaved, armed with spines, radiating from a common centre

(*n*) Temporary [illegible] ces for priests: derived from the Pali words *Pan*, leaf, and *sala*, shed. (*o*) Flat-bottomed boats, iron fastened, and with slidding roofs, thatched with *Cadjans*.

and the *stipes* sawed at the edges. The fan-part is about four feet in diameter; the spines are cut off, and the middle is formed into fans, or *punkahs*; these are lackered for sale, or used plain, as may suit the taste of the purchasers; but one never sees a Buddhist priest without one of the smaller sort, or a fan of some kind or other; of which, some are heart-shaped, others circular, with handles of carved ivory.

I have heard many arguments as to the fan being an emblem of authority; (*p*) and some pretend that the degrees of the Buddhist priesthood may be distinguished by their fans; but I do not state this as an ascertained fact, although I have myself observed that the handsomest *punkahs* are carried by the higher orders of the priesthood (*q*). Palmyra leaves are subdivided longitudinally into strips for native books and letters, and bear the general name of *Olas*. These are written upon with an iron style, and lampblack is then rubbed over the writing, which makes the characters more legible; this, from the smoothness of the surface, is easily wiped off, leaving the part that is not impressed by the style perfectly clean. The fruit, which is a large three-seeded drupe, grows in bunches, and is much esteemed. Palm oil is made of the pulp after having been exposed to the sun and become rancid. The spring leaf, or *Kellingos*, is a most excellent vegetable, when boiled or fricasseed; this the natives manufacture into a nutritious meal, or flour of delicious flavour, by cutting it off close after the seed nuts have been sown a few month, then drying it in the sun, and afterwards pounding in a rice mortar. The Dutch formerly considered palmyra flour so very valuable as a convalescent diet, as well as for presents to their friends, that they often exported to the Cape of Good Hope and Holland:—in both places it was much esteemed, and used for thickening, and imparting its peculiar flavour to soups and made dishes. Palmyra toddy is drawn from the flower, and good *Jaggery* is made from it by a similar process to that prescribed in the preceding pages. On the outside and at the base of the fronds, just where they rise from the stem, there is a soft cotton-like substance, of a light brown color, which is collected and employed by the native doctors for staunching blood or hemorrhage. The timber, being dark and beautifully striated, is very much esteemed for cabinet work; and by builders for rafters, &c. It is extremely durable, becoming harder and tougher with age.

The net of the indigenous palms, in point of domestic utility, is the sugar palm (*Caryota urens*, L.) or *Kitul Gaha* of the Sinhalese, of class XXI. Monœcia, and order VIII. Polyandria. Male flower *calyx*; universal *spathe*, compound; *spadix* branchy; *corol* three-parted; *petals* lanced, concave; *stamens*, filaments many, rather longer than the corol; *anthers* linear. Female flower upon the same *spadix* with the male ones; *calyx* common with the males; *corol* three-parted; *petals* pointed, very small; *pistil*, germ roundish; *style* pointed; *stigma* simple; *pericarp*, a berry, a roundish, one cell'd; *seeds*, two, large, oblong, roundish on one side, flat on the other. The berries are about two and a half or three inches in circumference, and are thickly studded upon dependent stems, from four to five feet in length, and about three feet in circumference, like a mass of closely knotted ropes, diverging from a common centre; these, when ripe, are of a brilliant red color, from which the *trivial* name of this palm is derived. The tree is straight in growth, and without fronds except at the top where they form a dark green crest but are different to those of the other indigenous palms, being *twice-feather-leaved*; and the leaflets are of triangular shape. The transverse division of the fronds are much esteemed by the native fishers for angling rods.

The *Kitul* seldom exceeds forty feet in height. The petioles leave their annular *vestigia* upon the bark, like those of the cocoanut and areka palms. The pith produces a nutritious sago; but, according to my humble judgment,

(*p*) St. Mathew particularly alludes to the fan (or winnow) in his 3rd chapter, verse 12.

(*q*) *Maha Nayaka Unnanse* signifies a high priest, and *Unnanse* a priest.—*Gurunanse* a teacher, and *Theruunanse* a reader.

it is very inferior to the brown sago of the Moluccas, or the white sort of China. The wood, when very old, is tough and heavy, and is made into rice pounders, bows (*r*) and pingoes for carrying burthens. The outer cuticle is so very strong and elastic that the natives make it into nooses and ropes for securing elephants. The toddy, which is also drawn from the flower, is so very luscious, that it is only drunk when that from the coconut tree cannot be readily procured. Eight gallons of this liquid, boiled over a slow fire, will produce four gallons of a very thick syrup, called *Kitul Penni*; to this also added small pieces of the bark of the *Halgas* (*Shorea robusta*), and being again boiled, double the quantity of *Jaggery*, and of a superior quality to that from the coconut palm, is the product. The Kandyan *Jaggery* is made entirely from this syrup, and will keep good for several years. Although the common sort is of the color of the coarser Muscovado sugar, a finer sort, of very superior quality, and the best substitute that can be obtained for Chinese sugar-candy, which it greatly resembles, is made for headmen. *Jaggery* is a principal ingredient in the *Chillum* used throughout India by *Hookah, Gur-Gurree and Habble-bubble* smokers. Clean chatties or calabashes are indispensable for collecting *sweet* toddy which would otherwise be affected by the acidity inseparable from using the same vessel twice, without being well washed and dried. The Ceylon calabash is a gourd (*Cucurbita lageuaria*, L.); that of the West Indies is the fruit of the calabash tree (*Crescentia cujete*, L.), which is not produced in Ceylon.

The *Jaggery*, or sugar makers, are called *Hakooroos* and toddy drawers, are *Chandoos*; but both are included in the subdivisions of the same caste (*Sudra Wause*), the second in rank of the principal Sinhalese castes. Each cake of *Jaggery* is separately enveloped in a piece of the dried leaf of the plantain (*Musa sapientum*, L.), or bauana (*Musa paradisiaca*, L.) and then suspended where smoke has free access to it, until required for the market or other purposes. The shape and size of a cake of common *Jaggery* is that of the bun of our English pastry cooks. The *Kitul* tree is more extensively cultivated in Saffragam, in the Southern Province, than in any other.

The next in value, but the most magnificent of Ceylon palms in appearance, is the talipat or umbrella-bearing palm (*Corypha umbraculifera*, L.); the *Licuala spinosa* of Thumberg, and *Talagaha* of the Sinhalese. Its classification has for many years been in a most undecided state. Thumberg describes the flower as follows,– *Calyx*; *perianth* one-leaved three-parted, hairy within; *corol* three-parted almost to the base, the divisions egg'd acute, concave; *nectary* garland form, twice as short as the corol; *stamen*, filaments six, inserted in to the nectaries, erect, very short; *anthers* oblong, twin; *pistil*, germ above, convex, furrowed, three-parted smooth; *style* one, simple; *stigmas* two. The talipat leaf is the largest known; it is circular, feather handled, folded, and intercepted with a thread. The natives subdivide it into eight parts, and these are sewed at the side with the natural thread, and ornamented with tale and various colors for the use of headmen. Its circumference is from thirty to forty feet; and it is so thoroughly impervious to the sun and impenetrable by the heaviest rains, that its value to the native traveller may be easily imagined. The most valuable of the Sinhalese books are formed of strips of the leaf; these are engraved with an iron style, and some now extant, although written many centuries back, have all their original freshness of appearance. Tents of all forms and sizes are also made of the leaf, supported by bamboo poles, than which nothing can be lighter for carriage or better for the purpose of temporary shelter.

One of the specimens of the talipat leaf that I brought with me from Ceylon, which measures thirty-six feet in circumference, may be seen in the Museum of King's College, with my name attached to it; but *how* it

(*r*) The elephant bows used by the natives of the Mahagampattu, in the Southern Province, are made of this wood, and tempered in the smoke of wetted rice straw, thrown upon a fire made of jungle leaves.

got there I have yet to learn. It is, however, most satisfactory to know that it is so well disposed of. The fate of the other is still a mystery; for although they were borrowed to be shown at certain scientific institutions, neither of them have found their way back to the proper owner for the last fourteen years. There have been many conflicting statements published of this palm; and although I never was within view of a talipat tree at the moment of its spadix bursting the spathe, it has been stated in one of the "Annuals" that I had witnessed it several times. This perhaps was not the first, nor has been the last, of the same author's *mistakes*; but I am not at all disposed, because I was not present, to dispute the native accounts of the loud report, with which the bursting of the talipat's compound spathe is accompanied, until it be refuted by some individual of unimpeachable veracity, who may have been *near the tree* at the time of its taking place, feeling satisfied, notwithstanding the opinions as to its gradual expansion, that in calm weather it may be heard at a considerable distance; for I was positively assured by several respectable Dutch inhabitants at Grand Pass, as well as by two intelligent Malays, who had resided for a considerable time at Matale, now part of the Central Province, where the *Talgaha* abounds, that the bursting of the spathe is attended with a loud report.

The native entertain a similar belief to that commonly entertained of the American aloe, that the talipat lives a century before it blossoms; but it is too well known that the growth of all the palm family is extremely rapid, and moreover that the heart of the talipat stem consists of a spongy fibre for this part of its description to be credited. In 1822, a talipat palm blossomed at Maholé, about six miles to the northward of Colombo; and for nearly three months, viz., from the time of the spadix bursting its spathe to the flower attaining its full height, (nearly thirty feet), and for a further space of four months before it seeded, the road was occasionally thronged with the curious, among them the "evening beauties" of the Pettah, on their way to view this wonder of the vegetable world ere its floral magnificence departed. Sago is prepared from the granulated pith of the talipat palm, which some consider equal to the true sago of the Moluccas; but if I may judge from the specimen that I brought with me to this country, it is even inferior to that of the *Caryota urens*, or *Cycas circinalis*. There are very few objects in the vegetable kingdom more beautiful or remarkable than this palm, or more useful to the countries where it is indigenous. There is a beautiful specimen of it in the compound of the Kacheheri at Colombo, where the casual visitor, who may not have time or opportunity for seeing in the interior, may gratify a very commendable curiosity.

The Buddhist priests had a same privilege as Royalty, in the reign of the late King, as to the talipat fan being borne over them with the broad end foremost; and M. de la Loubère, in his account of Siam, in alluding to the priests of Buddah, particularly mentions the talipat fan, "Pourse garantir du soleil, ils ont le talipat qui est leur parasol en forme d'ecran." In 1822 and 1825 I sent several talipat plants to the late Earl of Takerville,, Lord Bagot, and Horticultural Society of London from Ceylon; and in 1839, I presented the only perfect talipat seed that I had left to Mr. James Carter, the eminent seedsman of High Holborn. Be the quantity of rain what it may, not a particle of moisture is imbibed by the talipat leaf; and, exclusively of the uses made of it by all classes of the natives, as a defence from sun and rain, the Tavelam (*s*) people employ it for tents to cover their bags of salt on their journeys from the coast to the interior. A Tavelam *bivouac* is by no means an uninteresting sight to an European. Bags of salt are piled together, and the pointed ends of the segment of the talipat leaf are laid on the uppermost bag, so as to radiate from the centre by means of a heavy weight, which keeps them in that position; and, by means of *koir* or jungle lines and pegs

(*c*) See page 295 of Bennet's Ceylon.

the whole are kept in a circular shape, like a bell-tent, and afford a sufficient covered space around the salt bags, by way of verandah, for the traders and drovers to cook their victuals and take repose.

During my stay at Gedult, the Governor's country house at Mauritius, in 1821 I availed myself of his Excellency's (the late lamented Sir Robert Townshend Farquhar, Bart, K.S.L.) kind permission to select whatever plants I pleased from the Government garden; and amongst very many others, I took two of the date palm (*Phœnix dactylifera*, L.), and two of the *Cycas circinalis* L. to Ceylon: both the former died, but one of the latter, which I planted at Bagatelle near Colombo, was a very fine tree when I left the island, and the other was transferred by the late Honorable the Chief Justice, Sir Hardinge Giffard, to whom I had given it to the Royal Botanic Garden at Peradiniya, near Kandy, where it flourished as well as in its natural soil. Although Ceylon does not produce the date palm, there is no reason, why it should not, for two wild varieties of that palm (*Phœnix sylvestris*), called by the Sinhalese *Indi* and *Mahindi*, are plentiful enough, and well adapted for fences owing to their extremely strong and sharp spines. The drupe, which is rather more oblong, but not larger than a common Bullace plum (*Prunus insititia*, L.), and of a purplish black, insipidly sweet. There is also an indigenous species of dwarf palm or palmetto (*Chamærops*, L.), Class *Polygamia*, Order *Dioecia*, Natural Order *Palmæ*, of which small baskets (*Hewbili*) are made, the only purpose to which its leaves are applied.

CONTRIBUTION TO A NATURAL AND ECONOMICAL HISTORY OF THE COCO TREE, OR AS IT IS COMMONLY CALLED THE COCONUT TREE.

By Henry Marshall.

The earliest notice of the Coco tree which the author has seen is contained in an account of the travels of two Mahommedans in India and China in the ninth century, and a commentary on the work by Abu Zeid. Numerous descriptions of the tree and its products, more or less copious, have since that period been published, but in general the authors have devoted their attention principally to the natural history of the tree, and have given a less comprehensive account of its products as articles of commerce than they seem to deserve. With the exception of a paper in the Transactions of the Wernerian Natural History Society, the only monograph description of the cocoanut tree, with which the author is acquainted, is very brief in regard to the uses of the tree, although it was published so late as 1831.

In the following pages, the author has endeavoured to give a comprehensive account of the tree and its products; and has briefly detailed the more important facts which have been published on the subject, together with the result of his own observations during a residence of a number of years in Ceylon.

Description, &c.

The Coco tree (*Cocos nucifera*) belongs to the Class Monœcia, Order Hexandria, of the Linnean classification of plants. Natural Order Palmæ.

Roots slender and flexible, they rise separately like fingers from the stem, and do not penetrate to great depth in the soil.

Stem cylindrical, erect, but always leans to one side, crowned with a bunch of about 12 or 14 fronds (palm leaves,) from 1 to 2 feet in diameter, and from 60 to 100 feet in height, covered with a dun coloured coriaceous substance resembling bark. The diameter of the stem is increased by the addition of fibrous bundles to the centre, which being newly formed is the softest, and the outside the hardest;

the consolidating process goes on in some trees till the outside becomes so hard as to resist the blow of a hatchet. Small roots project from the stem for about two feet from the earth, by which means the trunk in old trees is much thicker for 2 or 3 feet, than it is higher up.

Leaves (fronds) clustered, forming a terminal head; youngest leaf rises from the centre of the tree, folded closely like a shut fan, and covered with a downy substance. The unexpanded leaves are pale yellow, and smooth, like fine satin ribbons; mature leaves are dark green: middle leaves are horizontal, rather drooping from 10 to 15 feet long, and in breadth from 3 to 4 feet, pinnated, or subdivided into two rows or leaflets; common petiole or leaf stalk naked near its base; leaflets numerous, sword-shaped, about 2 inches broad, placed in two ranks, which are a little inclined to each other.

Spathes or sheaths of the flowers oblong, acute, thick, fibrous, resemble paper in texture, open on the lower side. Admirably calculated to protect the inflorescence.

Flowers axillary, proceed from a large single-leaved pointed spathe. The spadix is spicate: each spike has towards its base one or two female flowers, the others being male. In both male and female flowers the calyx has three divisions and the corolla three petals. The male flowers have six stamens, and the female three stigmas.

Fruit about as large as a man's head, clustered, egg-shaped, obscurely three sided, with rounded angles external rind (epicarp,) thin, even-surfaced, tough. The fleshy part (sarocarp) is extremely fibrous, *nut* (putamen) originally triocular, but two of the cells are commonly obliterated, and one only comes to perfection, nearly globular, hard, one hole at the base, closed with a black membrane, two external depressions resembling holes. *Kernel* (endosperm) white, nearly ½ an inch thick, in substance and in taste resembling a hazel nut, or filbert, hollow, and containing about a pint of whey-coloured liquor; requires nearly twelve months to become completely ripe. Ripe nuts are known by a succession of the water within them on their being shaken. The embryo, which is a small oval body, is situated at the base or attached part of the nut, immediately under the membrane that covers the hole in the shell. When a coconut germinates, the embryo enlarges into a white spongy substance, which in time nearly fills the cavity of the nut. A shoot projects through the hole, which divides into an ascending and a descending portion, the former being the embryo stem, and the latter the rootlets. The water and kernel of the nut supply nourishment to the plantlet, and in the course of time they are in this way entirely consumed. When the shell has fulfilled its important purposes of preventing the exit of the water, and protecting the kernel from external injury, it crumbles into earth, but frequently not until it has been under ground for two or three years.

Matulla. This is the Sinhalese name of a remarkable substance resembling coarse cloth or gauze, which arises at the base and outside of the fronds, especially in young trees. Each portion is obtusely triangular, the base of the triangle adheres to the stem, while the other margins are attached to the stem and back of the frond. When young it has a very delicate texture, and a silvery white colour; the fibres diverge in an oblique direction, and generally there appear two or more layers of fibres connected by an adhesive substance, which cross each other obliquely. "The length and evenness of the threads or fibres, the regular manner in which they cross each other at oblique angles, the extent of surface, and the thickness of the piece, corresponding with that of coarse cotton cloth, the singular manner in which the fibres are attached to each other, cause this curious substance, wove in the loom of nature, to represent to the eye a remarkable

resemblance to cloth spun and woven by human ingenuity." (*Ellis Polynesian Researches.*)

Varieties of the Coconut.—Mr. Moon, in his Catalogue of the Indigenous and Exotic Plants of Ceylon, enumerates three varieties with several sub-varieties of the cocoanut, namely, the *common, eatable-husk,* and *king* cocoanut. There are two kinds of the eatable-husked cocoanut tree, which differ only in the colour of the fruit. It is the base of the husk that is eaten, which in taste and flavour resembles the cabbage or central bud of the same tree. This variety is much less extensively cultivated than the common kind, because it is not considered equally good for making curry, and the ripe nuts will not keep for any length of time. In Mysore, according to Dr. Buchanan, (*Travels in Mysore, Canara,* &c.,) there are four varieties of the cocoanut cultivated—1*st*, red; 2*nd*, red mixed with green; 3*rd*, light green; 4*th*, dark green. The red is reckoned somewhat better than the other, but they are commonly sold promiscuously, and the produce is nearly the same.

Geographical Distribution. This species of the palm family is a tropical plant, and requires a mean temperature of 72 Fahrenheit to bring it to perfection. According to Sir John Leslie's Table, (*Malte Brun's Geography,* Vol. i.) the mean temperature of

Lt.	27	is	73 8
	28		72 7
	29		71 9

In the kingdom of Assam, which lies between the 25*th* and 28*th* degree of N. L., the tree grows, but it is rare, and no palm wine is made from it. It is found also in the Canary Islands, which lie in the 28th or 29th degree of N. L. Under the equator it grows at an altitude of about 3,000 feet.

Cultivation of Cocoanut Trees. This tree is more or less cultivated on almost every coast and island within the tropics, where it was perhaps in general originally self-propagated. At Pericantral, on the south side of the Gulf of Cariaco, "the coco-tree is the principal object of cultivation." This palm thrives best in the neighbourhood of the sea, and, like the sugarcane, the plantain, the mammee-apple, and the alligator-pear, may be watered either with fresh or salt water. In other parts of Africa it is generally grown around palm-houses, but along the gulf it forms real plantations. Throughout this coast a coco-tree supplies annually about 100 nuts, which yield eight flascos of oil. The flascos is sold for 1s. 4d. A great quantity is made at Cumana, and Humboldt frequently witnessed the arrival there of canoes containing 3,000 nuts (*Humboldt's Travel, Edin. Cabinet Library*). It would appear by this statement that cocoanut oil fetches a much higher price in America than it does in any part of Asia.

The coco-tree is also cultivated on the Brazilian coast for an extent of 94 leagues. This tree is not indigenous in Pernambuco, but of all the trees which the Europeans have introduced it is by far the most important. The nuts are gathered four times a year, and form one of the chief articles of trade. No use seems to have been made of the husk of the nut in Brazil until the beginning of the present century, while the uses to which it might be applied and the mode of its preparation were pointed out by Dr. Manoel Aruda de Camara. (*Southey's Brazil*, vol. iii.) Coir has for a number of years been extensively manufactured at Recifi near Pernambuco

The cocoanut tree is, however, more extensively cultivated on the Continent and islands of Asia than in America. Pirard de Laval, who visited the Maldivian islands in 1601, states, that these small islands used to export annually about 100 ships loaded with cocoanuts. When he was there 400 cocoanuts cost a larin, which is about 8d. sterling. The cocoanut tree alone, he says, "might supply all the necessaries of life, for it affords wine,

honey, sugar, milk and butter, besides that its kernel may be eaten as bread, of which they have none in that country. Further, most of their utensils are made of the wood, bark, leaves, and nut-shells of the tree." The Mohammedan travellers who visited the Maldive islands in the ninth century state, that "the workmen in these islands are exceedingly expert, and make shirts and vests, and tunnies, all of one piece of the fibre of the husk of the coconut: of the same tree they build ships and houses." At the present time the principal exports from the Maldivian islands are coconuts, coconut oil, and coir. Indeed, all this group of islands is richly clothed with coconut trees. With respect to some of the Malay islands, it is alleged they would not be habitable without this palm, from their want of fresh water. The inhabitants give coconut milk (water) to their cattle, and never use any other beverage themselves. In such esteem is this tree held in the Maldive islands, and all along the Malabar coast, that it is a common saying among the inhabitants, "as fruitful, as profitable, as beautiful, &c., &c., as a coconut tree. The coconut palm is of great importance in some of the provinces south of Chittledroog (Peninsula of India.) Topes of them are seen everywhere and some valleys appear like forests of them." (*Heyne's Tracts on India.*) "At Chinapatnam, in Mysore, there is a tract of land that is about 18 miles in length, and from one mile to a quarter of a mile in width, the whole of which is, with the exception of some small spots, planted with coconut and betel palms." (*Buchanan's Travels in Mysore, &c.*) But perhaps the coconut tree is nowhere extensively cultivated as in the island of Ceylon. In 1813, it was estimated that 10,000,000 of trees were growing on the South-west coast only. But as this tree is planted more or less both on the east and west coast of the island, and in many places of the interior, it may be inferred that its cultivation is very extensive. Indeed the produce of the coconut and the cinnamon tree are, the chief staple commodities of the island. The cottages of the inhabitants are generally surrounded by a number of palm trees, more especially the coconut palm. In the Sinhalese language a coconut plantation is called *Polwatta*, while the European inhabitants called it a *toddy tope*. The word tope is probably derived from the English word *toft toftum* (Latin), an enclosed piece of ground round a dwelling. A ludicrous mistake is said to have been made by the use of the Anglo-Indian name of a coco garden. In a letter sent to England by a missionary, it was stated that they preached to the natives in *topes* of coconut trees. This expression was printed thus in one of the missionary journals, "they preached to the natives on *tops* of coconut trees." Serious accidents sometimes occur by the falling of coconuts from the tree. From the reports of inquests which took place in the island of Ceylon during the year 1833, it appears that four persons were killed by the falling of coconuts. It is remarkable that the coconut tree has never been introduced into the Andaman Islands, although it is very extensively cultivated in the Nicobar Islands, which are within 30 leagues of the little Andaman.

Soil. The coconut tree grows luxuriantly in the alluvial or sandy soil near to the margin of rivers, estuaries, and inlets of the sea. Koster observes that the sandy soils of the Brazilian coast, in which the coconut tree seems to delight, would, if they were not cultivated with it, remain almost useless, but from the produce which this tree yields, they are rendered very valuable. The lands which are occupied with this plant alone yield a settled income to the owners without much labour. Coconut trees are evidently not injured by the sea air, for they are nowhere more luxuriant than in situations where the roots are frequently washed by sea water. This palm grows, however, at great distances from the coast—in Ceylon it is profitably cultivated in the centre of the island, or about 100 miles from the sea, and in the peninsula of India 200 miles from the sea.

Propagation, Culture, and Produce.—The fruit of the coconut tree is admirably calculated for diffusion and self-propagation through the medium

of rivers and the ocean. Although the nut and its kernel, like many other seeds, is perhaps heavier than water, the fibrous husk with which it is invested gives it sufficient buoyance in water, by which means it is conveyed to the most distant coasts, even as far north sometimes as the coast of Norway. If by chance a coconut be carried by the sea to a favourable spot within tropics, it germinates and grows, bearing and disseminating many nuts, some of which by germinating form a palm grove, in which birds find a resting place. In this manner it is obvious a coral rock may, by means of sea-weed, in time be converted into an island, and eventually become inhabited with numerous species of the animal creation. The evidence in favour of this mode of the dissemination of prolific coconuts is so strong that I think the result cannot be doubted. I am well aware, however, that the germinating power of many seeds which are conveyed by the sea is usually lost before they reach a shore. The double coconut (*Lodoicea Sechellarum*), for example, has not, so far as I know, being propagated through the medium of the sea, although the nuts are frequently thrown upon the coast of tropical islands. Coconuts seem to be particularly well adapted for germinating and taking root upon the shelving and irregular surface of coral rocks. The lithophytæ do not build in compact masses, and the shelves are usually intersected with openings, sometimes narrow, and sometimes considerable width and depth. Coconuts have been planted in such shelf holes which have germinated and grow luxuriantly. The shelves are frequently covered with vegetable earth more or less mixed with sand.

Coconut plants are raised in the following manner: The requisite number of the ripe nuts are ranged in rows upon a smooth and rather hollow piece of ground, with the base of the nut uppermost. They are covered with a thin stratum of earth, in which state they remain for ten or twelve months, when they may be transplanted from the seed-bed to a tope or garden. The nuts and young plants require to be carefully watered during the dry season. In two or three months after the seed nuts are placed in the bed, the plantlet issues from the earth. The young shoot is much prized as an article of diet, and is sometimes eaten raw, but more frequently it is roasted in ashes or curried. The shoot attains the height of 16 or 18 inches during the first year, and the young resembles a bundle of narrow ribbons. The plants are sometimes not transplanted before they are three years of age, and the nut even then adheres to some of them, but not to all. In the toddy topes or coconut orchards, the distance preserved between the plants is usually from 20 to 21 feet. At this distance holes about 2 feet deep are made to receive the plants, and for the purpose of collecting moisture. The holes after they receive the young plants are only partially filled up with earth, and, probably from superstitious motives, a small quantity of salt is frequently placed under the plantlet. For three or four years the plants require to be fenced, so as to prevent them being injured by cattle.

The coconut tree, if planted in a good soil, blossoms and bears fruit at about 5 or 6 years of age. It continues to grow for about 30 years, bears fruit until it is 60 years old, and dies at from 90 to 100. The owner of a tope reaps the reward of his labour chiefly either in nuts, or by extracting a sweet juice, colloquially denominated toddy in India, from the flower, and various circumstances combine to make him prefer one crop to the other. A rotation or succession of crops is in this respect sometimes adopted. Drawing toddy from trees is said to be a very severe cropping if it be continued for more than one or two years; but when arrack, which is distilled from the juice is much in demand, owners of the coco plantations usually adopt the toddy harvest. When it has been resolved to draw toddy from a tope, the toddy-drawer makes a rope-ring with the young leaves of the tree, 10 or 12 inches long, into which he puts his feet to enable him in some measure to stand on the side of the stem. He places his feet close to the trunk, and then lifts himself up a little way with his

hands, and subsequently raises his feet. By the alternate exertions of his hands and feet, he soon reaches the top of the tree. The heads of the trees are connected with coir ropes, or more frequently by means of the stems of creeping plants, by which means the *chandu* or toddy-drawer passes from tree to tree upon the connecting creepers, assisted by the horizontal fronds. The toddy-drawers' tools are chiefly an earthern chatty or a calabash capable of containing several pints of sweet juice, and a broad knife and sheath, which, along with the calabash, is suspended from a belt round his middle. The mode of drawing the sweet juice will be subsequently described. The toddy is usually collected twice in 24 hours, the contents of each pot being poured into the calabash, which is conveyed to the ground by means of a coir cord, when it is emptied by an assistant toddy-drawer. There are individual native landholders in Ceylon who, according to account, possess 10,000 coconut trees on different plantations. The usual annual produce of a tree in this island may be estimated at about from 1s. 6d. to 2. In Bengal a coconut tree is commonly rented at 8 annas, or about 1s. 2d. per annum.

Diseases to which the tree is liable. The coriaceous epidermis or external rind of the stem of the coconut tree is about a quarter of an inch in thickness and very compact, by which means the light and heat of the sun are reflected from it in the hot and dry season, so that the tree is not excited to excessive action. In like manner the peculiarly compact, and in some respects smooth epidermis, especially of the nuts, prevents evaporation and parching in a very dry season; it also prevents excessive evaporation in the wet season, by which means the tree is not exposed to great changes of temperature.

Terminal leaf bud. This part of the tree is frequently injured by a species of the coleopterous tribe of insects, which is perhaps the *rhinoceros beetle* or *knife-grinder*, and sometimes a tree is thereby killed. The insect excavates a hole in the unexpanded bud, where its eggs are deposited. When the person who has the charge of a coconut plantation observes a hole in the cabbage or centre bud, he probes it with a barbed piece of iron, for the purpose not only of killing the grub, but of extracting it from its retreat.

Nuts. It is alleged that a considerable number of coconuts have no kernel. In some parts of India, the ratio or rotten nuts is situated to be as high as from 29 to 30 per cent.

Contraction of the Stem. In very dry seasons, and specially elevated localities, the central bud is occasionally not developed to its usual horizontal extent, and as the woody stem retains always its original diameter the trunk remains contracted. The concentric layers or circular rings of wood in exogenous trees which increase outwards, are frequently variable in thickness; so in palms which increase upwards, inequalities in layers occasionally occur. It is worthy of observation, that a number of rootlets commonly project from the stem immediately above the contraction, but they do not extend the above a few inches in length.

External Injury. When the central bud dies, from whatever cause, the trunk is rapidly reduced to dust, and a similar result happens when a stem is permitted to lie on the ground exposed to the various conditions of the atmosphere. The stem will, however, bear considerable injury when the head is not damaged. During the siege of Pondicherry in 1778, a cannon ball fired from the place accidentally struck a tree and passed through the trunk "as it it had gone through a mattress." In the course of time the perforation was filled up, and the wound perfectly healed. (*M. Le Goux de Flaix, Phil. Mag.*, vol. xx. and xxi.)

Coconut trees are occasionally struck with lighting, by which means the head is killed and the tree dies. The destruction of coconut trees, by severely injuring the central bud or cabbage, is one of the barbarities of war which is occasionally practised in those countries where this tree contributes materially to the sustenance of man. It is alleged that rats

prey on the young nuts, more especially in very dry weather, as they afford not only meat but drink also. Trees are sometimes undermined and unrooted by ants.

SYNONYMS.

Sana Pala	Pali.
Nari Kaylum Tangadra	Sanscrit.
Nareil ...	Hindustani.
Polgaha	Sinhalese.
Tenga ...	Rheede Hort. Mal.
Taygana	Canarese.
Tenkay, Narica, Kobari	Telinga.
Kalapay and Nyor	Malay.
Haari ...	Otaheitan.
Cagolli...	Mexican.
Masogna Inaiguaruiba	Brazilian.
Cay Dua	Cochin Chinese.
Yai Xû	Chinese.
Jowzhiud	Arabic.
Narjible	Persian.
Palma Indica, Coreifera Angulosa	Burman, Zeyl.
Calappa Palma Indica Major	Rumph. Amb.
Cocos Palma	Loureiro.
Cocotier or Cocos	Labat.
Coco, or Coconut Tree, frequently mis-spelled Cocoa	English.

Many unsatisfactory conjectures have been made with respect to the derivation of the European name of this tree. Dr. Johnson derives it from *Cacaotal* (Spanish), and therefore, he adds "more properly written *Cacao*." He obviously mistakes the coconut tree for the *Theobroma Cacao* which produces the cacao beans. Mr. Booth in his analytical Dictionary says: "The fruit (of the coconut tree) is named *coco* by the Portuguese, from the three holes at the end of the shell, which give it the appearance of the head of a monkey." In all probability the word coco and its European synonyms are derived from the Greek word *Kocos* a seed, nut or shell. Avicena who lived in the tenth century, calls this tree *Graf Alhend, Nucis Indicæ*, the nut of India. The old travellers and naturalists give it a similar designation, namely, the cocos or cocus tree of India, which is synonymous with the nut tree of India, consequently this palm should properly be called the coco or nut tree, although I have commonly employed the duplicate name by which it is generally known, viz., the coconut tree.

ECONOMICAL QUALITIES.

Roots. The roots are sometimes chewed as a substitute for the areca-nut. In Brazil and also in the Tonga islands the natives interweave the roots with plait made of the fibrous bark, and thereby manufacture them into beautiful baskets, which are sometimes ornamented with beads or shells incorporated in the wicker work.

Matulla.—This cloth-like net-work is much used as a filter, especially for straining toddy and coconut oil. It is also employed in some countries as sieves for preparing arrowroot. In the South Sea Islands it is much used by the natives as a substitute for cloth in constructing garments, particularly for individuals who are engaged in such occupations as digging and fishing. Matulla garments are well calculated for fishermen or persons employed on the beach, as they are but little injured by sea-water, whereas articles of dress made of bark-cloth would thereby be completely destroyed.

The Papuas of New Guinea seem in general to make the garment which covers the lower part of the body of this substance. Sometimes it is made into sails for canoes. The more slender fibres resemble waxed thread, for

which they may be used as a substitute. They are from about 1 to 2 feet in length, according to the size of the tree upon which the Matulla is found.

Stem.—The wood of young trees is, as Linschoten states, "sappy like a sponge, and is not firm," consequently, it is comparatively of little use. The wood of old trees is valuable for a great variety of purposes in the construction of houses, and especially as pillars, wallplates and rafters.

The best spears of the Otaheitans are made of the coconut tree. In India the lower part of the stem is much used in making tom-toms (small drums). It is now, I am informed, imported into the European markets under the denomination of porcupine wood. For domestic purposes the native workmen manufacture potash from the ashes of the stem and leaves.

Leaf-bud The unexpanded or terminal leaf-bud is much prized as an article of diet by both Europeans and natives, but as the tree dies when the bud is cut off, it is seldom obtained except when a tree is blown over by the wind. When boiled it is extremely delicate, and resembles filbert or very tender vegetable. The natives preserve it in vinegar, and eat it as a pickle. An ordinary sized coconut cabbage, as the bud is frequently denominated, is about 2½ feet long and 1½ feet in circumference, and weighs from 20 to 30 pounds.

Fronds or Leaves.— The mature leaves of coconut trees are applied to a great variety of purposes.

Food for Elephants.—Tame elephants are chiefly fed upon coconut leaves in Ceylon, and these animals evince much sagacity in preparing them for mastication. They tear the leaflets from the petiole or middle stem of the frond, and switch a bundle of them round the fore-leg, by which means the elastic midrib of each leaflet is separated from the softer margin of the leaves which is eaten, and the midrib is rejected.

Domestic Utensils and other Purposes. The leaves, either entire or divided longitudinally, are manufactured into baskets, lanterns, mats for the ceiling of rooms, carpets, sails for canoes, coffins or baskets for containing dead bodies, temporary tents for covering palanquins, fences, &c. A large portion of the houses and huts in India are thatched with coconut leaves, and frequently the walls or sides are constructed of the same materials. When the leaflets are interwoven, and thereby prepared for thatching houses, &c., they are named *Cadjans* in Ceylon.

Dress Ornaments, &c. The inhabitants of several of the South Sea Islands manufacture a kind of mask or vizor of the leaves of the coconut tree, which they wear to defend their faces from the scorching rays of the sun. Hats and beautiful bonnets are made of the young leaves by the Otaheitan ladies. They also manufacture a kind of artificial flowers, by extracting the petals of the most fragrant flowers and fastening them upon the elastic midrib of the leaflet. These flowers are sprinkled with scented oil, and worn in bonnets made of the coco leaf. A gentleman who lately visited the Tonga Islands, and who devoted much attention to the dress of the ladies on days of festivity, says: "We admired every ornament until, to complete the dress, quantities of coconut oil were lavished over the head, arms, neck, and part of the body." In Ceylon the young leaves are much employed to ornament ball rooms and places of public resort. In the Tonga Islands the warriors have on particular occasions streamers or pennants composed of the young leaf, attached to their heads and arms, full 13 feet long, which, by floating in the wind, produce a most romantic effect, and in the Marquesas and Washington Islands, the official or distinctive dress of the priests is made of coconut leaves. The cap or head-dress is thus prepared: A portion of the petiole or middle stem of a leaf is placed perpendicularly over the forehead, and the leaflets still attached to the stem are passed round the head on each side and neatly fastened together behind. In addition to the uniform cap the priests when on duty wear a cape or cover-

ing over the shoulders made of the same materials. In Ceylon, labourers sometimes protect themselves from rain while at work by means of a hood or long mantle made of coconut leaves.

Marks of Respect, Emblem of Authority, &c. The practice of showing respect to individuals by means of the branches of palm trees appears to be very ancient. (See Matthew, xxi. 8, Mark xi. 8, and John, xii. 13.)- The foliage of the palm tribe of plants has been in many countries considered an emblem of joy and victory, and hence the word *palm* is sometimes employed as a synonym of victory and triumph. See Leviticus, xiii. 40. It is remarkable that a similar mode of showing respect by "waving palm branches," prevailed among the aborigines of America when it was discovered by Columbus. In ancient times, when pilgrims resorted to Palestine, they commonly returned bearing a branch of palm tree, which sanctioned mendicity, and hence they were denominated *palmers*. Captain Lyon is, when describing the amusements of the natives of some parts of Northern Africa, informs us, that the dancers "were directed by an old woman, with a torch in one hand, and a long palm branch in the other, and sung in chorus verses which she repeated to them." The young yellow leaves are in Ceylon much employed to evince respect to persons in authority: such as the Governor or Chief Justice. When they travel from one part of the island to another lines made of the stems of creeping plants are stretched along each side of the road on which are suspended strips of the leaves.

The leaflets of this tree were until lately the emblem of authority throughout the whole of the Georgian and Society Islands, and requisition for property or labour, preparations for war, or the invocation of a general assembly were formerly made by sending a coconut leaf to those whose services or attendance were required. To return or refuse the leaflet was to offer an insult to the person in power. Bunches or strings of the leaflets used to be suspended in the temples, which answered the purpose of rosaries in their devotions. By this means the priest or the worshipper was reminded of the order of his prayers.

Fishing for Cowries. In this process the plaited branches or fronds (Cadjans) of coco trees are in the Maldive Islands laid together and lashed up into bundles about the thickness of a wheat sheaf, two of which constitute what is called a *balsa*. On these balsas the fishermen take a number of lines baited with short threads attached to them at every five or six inches distance, and each with a bit of putrid meat for bait, tied by a knot to prevent it slipping off. The shell-fish swallow the bait, knot and all, by which means it is hauled up with the line. When the balsas are loaded they are paddled ashore, and the shells buried until the molluscous animals putrefy. They are then washed, and, as Barras states, "being so much better than copper for money, as they neither soil the hands nor render offensive odours." *Journal of the Royal Geographical Society*, vol. ii. 52.

Torches. -The Sinhalese use the dried fronds as torches to carry before the carriages and palanquins of Europeans or native chiefs, when they travel during night, as also for their own purposes, especially in catching fish. Torches are also much used by the agricultural population for the purpose of preventing the inroads of wild elephants; every field under cultivation in the interior must be watched for that purpose after sunset. The Sinhalese name for torches is *hooln utta*, which is corrupted by the Europeans into *Chuhus*.

Paper. - The coconut leaflet is sometimes used to write upon for common purposes. The leaves of the Palmyra palm (*Borassus flabelliformis*) are more frequently employed as a substitute for paper than coconut leaves, being considerably broader. But all the valuable manuscripts in India and the Eastern Archipelago are written on the leaves of the *Corypha umbraculifera*, which is called *Cuda panna* by the Tamools,

and *Talpat* by the Sinhalese. This is the *Talipot* tree or great fan-palm. Talpat simply means palm leaf, from *Tal*, palm, and pat, leaf. The ordinary dimensions of the leaf of a talpat book is about 2 or 2½ inches wide, and from 18 inches to 2 feet in length. The texture of the leaves of these three varieties of the palm tribe is very similar. Purchas denominates them most appropriately "leaf parchment. For this purpose the immature leaves are selected and dried in the shade; they are then dipped for a short time in hot milk or water, and subsequently smoothed or polished by being rapidly drawn round a post. The pen employed to write upon the leaf is an iron stylus or pointed instrument, which, by scratching the surface, makes an impression on it that is easily legible. Sometimes the impression is covered with a colouring substance, such as a solution of gum and lamp-black, coco oil, or cowdung, applied in the same manner as engravers cover their copperplates. The native writers in India write upon palm leaves, which are technically called *olas*, with great rapidity, indeed, they direct the stylus with such dexterity that they turn their faces frequently from the leaves and entertain others with talking whilst they are writing. Palm leaves are much more durable than our paper, especially in warm moist climates, such as Ceylon, where paper become soft, and is destroyed by insects, and where the ink fades and becomes scarcely legible. Linschoten, who visited India in 1583, gives the following graphic account of a young leaf of the coconut tree, and of the uses to which it is applied. "It is as thin as paper, and also white, and is as if it were pleated or prest together as they use to pleat and press women's huykes in the low countries: it is also long and slender, and hath sometimes fifty or sixty folds or plates in it like a paper book. This the Indians use for paper and books whereon they write, and then it is impossible to get the letters out again, for it is printed thereon with a kind of iron instrument. The Indians call it *olla*, whereof all their books, writings and evidences are made which they can seal and shut up as we do our letters." At present *olla* letters are conveyed in Ceylon by means of the regular post in the usual manner. The leaf is rolled up and sealed with gum lac. The most ancient materials for writing upon was stone or brick. In the days of Job sheets of lead were used for a similar purpose, and the pen employed was an iron stylus. (Job chap. xix. 23, 24). Plates of copper, tablets of wood, and leaves of trees were also used in ancient times as writing materials. Subsequently the skins of animals were employed.[9] Job speaks of no other pen but the iron style, which is the graver or instrument that is at the present day universally employed in India for writing upon the leaves of the Coco, the Palmyra, and Talipot tree. It is highly probable that the leaves of some of the palm family were used for writing upon as early as the time of Job. In chap. xxxi 35, he speaks of writing "a book," upon which passage the learned President de Gognet, in his work on the origin of laws, &c., observes, "I cannot imagine what could be the form or materials of books in that age." The Talipot leaf is sometimes used as paper and written upon with ink, which is probably the ink commonly employed by the natives of India, namely, a mixture of burnt rice and gum water. There are some beautiful manuscripts of this kind in the museum of the East India Company, Leadenhall Street.

Petiole or Stripe and Midrib of the Leaflet.—The stripe is much used as an oar or paddle, also to construct fences, and when bruised at one end a brush is formed which serves to whitewash houses, &c. Basket nets for catching fish, shrimps, &c., are made of the midrib of the leaflet, as also panniers and baskets. It is much employed also as brooms, tooth-picks, pins, and to make sieves, which are used in the manufacture of sago. It has been recommended to be employed as a nucleus for bougies. The South Sea Islanders make combs of

this part of the leaf. In India and the oriental islands the dishes used by the natives are commonly portions of the plantain leaf, but individuals of the caste of Brahmans generally eat from plates made of the leaves of the Jak-tree (*Artocarpus integrifolia.*) sewed or pinned together by means of portions of the midrib of the coconut leaf. A Brahman is not permitted by the rules of his caste to eat twice from one plate. Javelins or spear handles are made of this part of the leaf, the requisite number of the elastic fibres being bound together and covered with gum lac.

Spathes.—The membranous sheath which covers the blossoms is inflammable, and it is often employed as torches; in some parts of India it is soaked in water, and converted into coarse cordage. In the South Sea Islands it is employed in a green state by females as an apron or substitute for a petticoat, and in the Maldive Islands liquid measures are made of this part of the tree.

Gathering of the Nuts. The nuts are collected in Ceylon by persons of the Chandu caste or tribe, who ascend the trees in the usual manner, armed with a large knife, which is required to divide the strong stems of the spadix. Even when it is necessary that the nuts should be ripe, they are collected a little before they fall from the trees. "To fetch coconuts from trees as they are wanted, the Malays of Sumatra have trained monkeys, which are more expert at the business than any toddy-drawer on the coast of Coromandel." (*Heyne's Tracts on India, &c,*)—Sir Thomas Raffles informs us that the species of baboon which is trained for this purpose is the bruh of the Malays (*Simia Carpolegus.*) The natives distinguish three varieties of bruh, one of which is the *Bruh Setapong.* This variety is the largest, and is also the most docile and intelligent of the whole, consequently it is much prized. When sent to gather coconuts, he selects the ripe ones, and pulls no more than he is ordered.—(*Trans. Lin. Society,* vol. xiii. page 214.)

Superstitious Uses of Coconuts.—In times of unusual sickness, the natives of some of the South Sea Islands, as also the native inhabitants of Ceylon, make offerings of coconuts to the supposed offended spirits, which they believe occasion disease. Mariner (*Account of the Natives of the Tonga Islands, &c.*) mentions a charm in the Tonga Islands, which consists in spinning a coconut, and, judging by the direction of the upper part when again at rest, of the object of inquiry, which is chiefly whether a sick person will recover. For this purpose, the nut being placed on the ground, a relation of the sick person determines, that, if the nut when again at rest points to such a quarter, the east, for example, the sick man will recover; he then prays aloud to the patron god of the family, that he will be pleased to direct the nut, so that it may indicate the truth. The nut being next spun, the result is attended with a full conviction, that it will truly declare the intention of the gods at the time. The women often spin a coconut to decide some dispute at a game. In the Nicobar Islands, a coconut tree is cut down when a person dies; and in Ceylon, young coco leaves are suspended over the spot where the body of a chief or priest has been burned.

Miscellaneous Uses.—In some parts of India, the coconut is employed as a symbol of matrimonial alliance, and in Ceylon the shells of green coconuts are occasionally used as lanterns, which are translucent. A coconut is the common present by which the lower classes in India endeavour to conciliate the favour of the upper ranks. In the Maldive Islands, coconut are the price of labour, in fact, the circulating medium.

Unripe Nuts.—To afford nourishment to the germ and embryo plant, a watery fluid is secreted, which is converted into seed-pulp or kernel. The water contains sugar and a gummy matter, and the kernel is composed of a fixed oil or vegetable butter, albumen and liquid sugar. In chemical

composition the kernel is supposed to have a close analogy with the milk of animals, and it is considered to be very nutritive.

The indigenous inhabitants of tropical Islands, such as Ceylon, subsist in a great degree upon the water and pulpy kernel of unripe coconuts. The water is in "colour like whey, and of that consistency, but in relish far excelling." *(Dr. Eyger's Travels.)* When drunk fresh from the tree it is considerably cooler than the atmosphere, and consequently very refreshing. "In the Tonga Islands, coconut water is the chief drink, as the wells are merely tide wells, which increase and diminish as they rise and fall." The great Comoro Island, which is 30 leagues in circumference, is said to retain no water in its soil, being volcanic: and the natives are frequently obliged to satisfy the thirst of their cattle with coco water, and never drink any other beverage themselves. The pulp or soft kernel of a young coconut has been not inappropriately denominated a vegetable blanc mange. It may in this state be eaten with a spoon, and when a little Madeira wine, lime juice, sugar, and nutmeg are added, the mixture is generally considered very delicious. The confectioners of India make and vend nearly 100 sorts of sweetmeats, and the kernel of the coconut is the principal fruit which enters into their composition. In a more mature state, the kernel is eaten by the natives of the Ladrone Islands in place of bread. The natives of the Sandwich Islands prepare a rich sauce with very finely grated young coconuts, which undergoes before use a slight degree of fermentation. This sauce is prepared with much care, and being deemed a great luxury, it is usually considered an essential dish at their public entertainments. Coconuts are eaten both by domesticated and wild animals. Captain Hamilton (*A new Account of the East Indies*, &c.) informs us that all the domestic animals in the Nicobar Islands are fed upon coconuts and sea water, and that upon this diet hogs become remarkably fat. According to another authority, when pigs are fed with the water and kernel of coconuts, the meat is firm, and has a delicious taste, even superior in colour and flavour to the best English veal. In some of the South Sea Islands, Mr. Montgomery (*Journal of Voyages and Travels by the Rev. Mr. Tyerman and Mr. Bennet.*) informs us, that the land crabs live under the coconut trees, and subsist upon fruit which they find on the ground. With their powerful front claws they tear off the fibrous husks; afterwards inserting one of the same into a hole at the end of the nut they beat it with violence against a stone until it cracks. The shell is then easily pulled to pieces, and the kernel devoured at leisure. Sometimes, by widening the hole with one of their round gimblet claws, or enlarging the breach with their forceps, they effect sufficient entrance to enable them to scoop out the kernel without breaking the nut. These crabs burrow under the coconut trees, prudently storing up in their holes large quantities of nuts stripped of the husk, at those times when they are most abundant, against the recurring intervals when they are scarce. The *Birgus latro*, a species of sea crab, frequently quits the sea and ascends the coco tree and other palms for the sake of their fruit. These crabs are very fond of the fruit of the coco palm, and may be fed with it for months without their suffering from want of water. *(Kirby's Bridgewater Treatise*, vol. ii. 48.)

Ripe Nuts. Unripe nuts are designated by the Indo-Portuguese inhabitants *Lania*; when ripe they are called *Curry coconuts*, as being fit for yielding milk adapted for cooking. The ripe kernel is much used in India as an article of diet by the natives, and it is commonly eaten with jaggery (coarse sugar). In this country it sometimes appears on the tables of the wealthy as a dessert.

Coconut Emulsion or Milk. -To prepare coconut milk, the ripe kernel of a nut that has been divided into two is, in Ceylon, reduced to the size of common saw-dust, by means of an instrument called *Hiramane*, which is a notched circle of iron, fastened to the raised end of a piece of wood. The hiramane is the best kind of grater that can be employed to reduce the

l that the product is nearly 8 gallons of oil, equal to 64 pounds, so that ounces of copperas will yield 16 ounces of oil. The oil cake is called *ak* in Ceylon, where it is chiefly employed to feed pigs, poultry, &c., on the peninsula of India the natives eat it dressed in various ways.

Miscellaneous Use of Cocoanut Oil. Cocoanut oil prepared by decoction, l in a fresh state, is used by the natives of Ceylon as an article of diet, ecially for frying cakes, fish, &c. When newly prepared by decoction as no disagreeable odour, but it soon becomes very offensive to Euro- ns. This oil has, I am informed, been successfully used in the manu- ture of cloth, as a substitute for olive oil. Glass-blowers prefer it to others in their operations; mixed with crude turpentine as it exudes n pine trees, it is much employed for smearing sheep. Combined h dammer, a kind of turpentine or rosin, that flows spontaneously n the *Pinus Dammara* which grows in Ceylon, Sumatra, and the Malay insula, and the mixture heated or melted, a compound is formed, which much used for the seams of ships. The same compound is employed India to protect the corks of wine and beer bottles from the depreda- ns of white ants. The mouth of the bottle after it is corked is first ped into the melted compound and immediately after into siliceous d. This apparently impregnable shield is not always successful in isting the inroads of these insects. The process of mummification is l to be promoted by means of cocoanut oil. The method pursued at heite for desiccating the human frame is to keep the corpse constantly ed, dry, and well lubricated with oil (*Beechy's Voyage, &c., page* 125). ome of the South-Sea Island, the oil is employed as currency in the hange of commodities. The London Missionary Society received con- utions of cocoanut oil from the natives of Otaheite, which seem to have n not always cheerfully bestowed. On one occasion a man brought a tribution of oil to King Pomari, and said in an angry tone:—"Here are bamboos oil, take them for the society." "*No*," said the King, "I will mix your angry bamboos with the missionary oil; take them away." ording to Pomari's revenue laws, the governor of a district is to pay nally "two hogs or ten measures arrow-root; if not this, cocoanut oil bamboos full; they must be good-sized bamboos." *-(Ellis).*

Light-giving Uses.- Cocoanut oil is used in India by all ranks, both opean and native inhabitants, as a lamp oil. Mr. Deville, of the Strand, don, who has paid much attention to the illuminating qualities of erent gases, is of opinion that the gas-light from cocoanut oil has so far quality of day-light, that with it the difference between flower of hur and wheat flour may be easily distinguished, which he was unable o with any other artificial light.

Elaine and Stearine of Cocoanut Oil.- A patent was taken out in this ntry in 1829 for a process by which the crude oil may be separated into substances, namely, a purely limpid oil (*Elaine*), and an unctuous solid stance (*Stearine*). The separation is effected by means of great pres- . The crude oil is put into linen bags, which are covered with strong vas, laid flat upon the horizontal bed of a hydraulic press, and sub- ted to compression. A liquid oil (the *elaine*) is thus obtained. The tents of the bags are then put into a tinned copper boiler and sub- ed to heat, in a steam bath, and the heat is kept up for a sufficient gth of time to allow the impurities to subside. The stearine thus pro- d, which amounts to about 31 per cent. of the crude oil, has a firm sistence and a fine glassy whiteness. The elaine or fluid oil is purified n admixture of from one to two per cent. by weight of the sulphuric l of commerce, diluted with six times its weight of water. The acid tion and the oil are violently agitated together for some time, and rwards allowed to settle. Some impurities subside, which are rated from the pure oil by filtration through thick woollen cloth. The eation of expression cocoanut oil is carried on while the temperature

I'll take notice of one they call *Deu Pario* (which seems to be *Qoormu*, spelled by the ear curry), made of venison cut in slices, to which they put onions and herbs, some roots with a little spice, and butter, the most savoury meat I ever tasted, and you almost think it that very dish which Jacob made ready for his father when he got the blessing."

Coconut emulsion is sometimes used as a substitute for cow's milk in tea and coffee, as also for dressing sago. Dampier informs us, that "in this milky water they boil a fowl or any other sort of flesh, and it makes very savoury broth." The grated kernel sometimes enters largely in the composition of puddings, and it is also frequently mixed with rice. In almost all the South Sea Islands the indigenous inhabitants live much upon meat, fish, fruits, and roots, dressed in coconut milk, which furnishes an oleaginous substance, or vegetable butter, much suited to the general taste of mankind.

The Otaheitans prepare a sauce with ripe nuts by cutting the kernel into thin slices, and putting it into a calabash with salt water, in which it is shaken every day until the nut is dissolved. The mixture is eaten by the natives as sauce to their fish, bread-fruit, and almost every other article of food.—(*Ellis*, vol. i. 65.)

Preparation of Coconut Oil by Decoction.—The ripe kernel after being cleared of the brown membrane which adheres to its outside is boiled in water, and then pounded in a *wang-gedea* or large mortar, hollowed out of the trunk of a tree. The solid parts are then separated from the emulsion or milk, which is boiled over a slow fire until the oil floats on the top, when it is skimmed off with a coconut shell ladle. Sometimes the oil is boiled a second time.

As the process of boiling the emulsion is tedious and comparatively expensive, a more economical method is occasionally practised; it is left exposed to the air for a night, during which period the oily portion of the emulsion rises to the top, when it is skimmed off, and purified by a very short boiling. In Otaheite the grated kernel is exposed to the sun, and in the course of time the oil separates spontaneously, when it is eventually put into bamboo bottles, and in this way it is brought to market. The quantity of oil yielded by decoction is variously stated. Bertolacci informs us that on an average ten nuts will yield about a quart of oil. Another Ceylon authority says, "two quarts of oil will be the product of fourteen or fifteen coconuts. Dr. Camara, quoted by Koster, states, that he made the experiment, and found that thirty-two nuts yielded only three pounds of pure oil.

Physical qualities of Coconut Oil.—This oil fuses at a temperature of about 80° of Fahrenheit, and it becomes concrete at 77° or 78°. In this country it has a yellowish white colour, and a consistence resembling soft tallow.

Preparation of Coconut Oil by Expression.—After clearing the nut of its husk, the kernel is exposed by breaking the shell with a heavy crooked knife, an operation which is generally effected by one blow. The divided nuts are then spread upon an open platform made of bamboos or laths of the *Areca* tree, under which a charcoal fire is placed, which is kept up for two or three days in order to dry the kernels. After this process is completed, they are exposed to the sun on mats, as a preliminary measure to their being put into the press. The kernels being separated from the shell are then called *copra* or *copperas*. The native machine or mill used for extracting coconut oil consists of the trunk of a tree hollowed out into a large vase or mortar, in which an upright cylinder is turned by means of a horizontal beam worked by two oxen. The machine is usually erected in the open air. Dr. Buchanan informs us, that the mill or mortar is in India, charged with about 93 pounds of copperas, and 3 quarts of water,

and that the product is nearly 8 gallons of oil, equal to 64 pounds, so that 24 ounces of copperas will yield 16 ounces of oil. The oil cake is called *ponak* in Ceylon, where it is chiefly employed to feed pigs, poultry, &c., but on the peninsula of India the natives eat it dressed in various ways.

Miscellaneous Use of Coconut Oil.—Coconut oil prepared by decoction, and in a fresh state, is used by the natives of Ceylon as an article of diet, especially for frying cakes, fish, &c. When newly prepared by decoction it has no disagreeable odour, but it soon becomes very offensive to Europeans. This oil has, I am informed, been successfully used in the manufacture of cloth, as a substitute for olive oil. Glass-blowers prefer it to all others in their operations; mixed with crude turpentine as it exudes from pine trees, it is much employed for smearing sheep. Combined with dammer, a kind of turpentine or rosin, that flows spontaneously from the *Pinus Dammara* which grows in Ceylon, Sumatra, and the Malay Peninsula, and the mixture heated or melted, a compound is formed, which is much used for the seams of ships. The same compound is employed in India to protect the corks of wine and beer bottles from the depredations of white ants. The mouth of the bottle after it is corked is first dipped into the melted compound and immediately after into siliceous sand. This apparently impregnable shield is not always successful in resisting the inroads of these insects. The process of mummification is said to be promoted by means of coconut oil. The method pursued at Otaheite for desiccating the human frame is to keep the corpse constantly wiped, dry, and well lubricated with oil (*Beechy's Voyage, &c., page* 125). In some of the South-Sea Island, the oil is employed as currency in the exchange of commodities. The London Missionary Society received contributions of coconut oil from the natives of Otaheite, which seem to have been not always cheerfully bestowed. On one occasion a man brought a contribution of oil to King Pomari, and said in an angry tone:—"Here are five bamboos oil, take them for the society." "No," said the King, "I will not mix your angry bamboos with the missionary oil; take them away." According to Pomari's revenue laws, the governor of a district is to pay annually "two hogs or ten measures arrow-root; if not this, coconut oil ten bamboos full; they must be good-sized bamboos."—*(Ellis).*

Light-giving Uses.—Coconut oil is used in India by all ranks, both European and native inhabitants, as a lamp oil. Mr. Doville, of the Strand, London, who has paid much attention to the illuminating qualities of different gases, is of opinion that the gas-light from coconut oil has so far the quality of day-light, that with it the difference between flower of sulphur and wheat flour may be easily distinguished, which he was unable to do with any other artificial light.

Elaine and Stearine of Coconut Oil.—A patent was taken out in this country in 1829 for a process by which the crude oil may be separated into two substances, namely, a purely limpid oil (*Elaine*), and an unctuous solid substance (*Stearine*). The separation is effected by means of great pressure. The crude oil is put into linen bags, which are covered with strong canvas, laid flat upon the horizontal bed of a hydraulic press, and submitted to compression. A liquid oil (the *elaine*) is thus obtained. The contents of the bags are then put into a tinned copper boiler and submitted to heat, in a steam bath, and the heat is kept up for a sufficient length of time to allow the impurities to subside. The stearine thus procured, which amounts to about 30 per cent. of the crude oil, has a firm consistence and a fine glassy whiteness. The elaine or fluid oil is purified by an admixture of from one to two per cent. by weight of the sulphuric acid of commerce, diluted with six times its weight of water. The acid solution and the oil are violently agitated together for some time, and afterwards allowed to settle. Some impurities subside, which are separated from the pure oil by filtration through thick woollen cloth. The operation of expression coconut oil is carried on while the temperature

varies from 50° to 65°. The lower the temperature at which the separation of the elaine from the stearine can be effected, the better will be the quality of the fluid oil. There is a large manufactory of elaine and stearine of this kind in operation near to Vauxhall Bridge, London.

Uses, Candles, Soap. The fluid oil is well adapted for burning in lamps, but the temperature of the atmosphere should not be much below 60° Fahrenheit, as it is apt to become thick when temperature is low. It may also be employed for sharpening instruments, oiling clocks, &c. This pure oil is retailed at the rate of 1s. per gallon. Candles are made of the *stearine* or solid matter, which rival wax in appearance and durability; they burn with a pure white flame and emit a steady light. They are retailed at from 10d. to 1s. per pound. Some manufacturers of soap employ a considerable quantity of crude oil along with the common materials used for making that article. It is alleged that a certain portion of coconut oil has the effect of preventing soap from cracking in dry weather. Candles of a remarkably good quality have been made of coconut oil by first manufacturing it into soap, from which the alkali used is subsequently separated by means of an acid. The residual masses is well washed with water, and afterwards submitted to a hydraulic press; it is then melted and made into candles. The candles thus prepared are as white and hard as those made of wax or spermaceti. The manufacture of candles by this process was, I am informed, first tried in Berlin.

Trade in Coconut Oil.—Until lately the importation of coconut oil into Europe has been liable to much waste by leakage through the wood of the casks. This circumstance has been completely obviated in Ceylon by filling the casks, and exposing them to the sun for sometime and occasionally rendering the hoops firmer. Coconut oil is also sometimes imported in iron tanks, but this mode is liable to many inconveniences, and it is therefore much disliked by captains of ships. In India where coconut oil is always fluid, it is easily pumped, or otherwise introduced into the tank; but as it becomes more or less solid at between 70° and 80° of temperature it is not so easily removed, for a merchant's scow, when it is imported in tanks as in casks. The casks are generally leaguers which contain 150 gallons, and the export price is commonly from £6 10s. to £7, per leaguer. The custom-duty levied upon oil imported into this country is 1s 3d. per cwt., and the ordinary price of it in the market varies from £30 to £36 per ton, or from £15 to £18 per leaguer. There is a considerable quantity of an inferior quality of oil exported from the Society Islands. The trade in this, as also of some other articles of commerce, is said to be chiefly in the hands of the missionaries. In the London prices current coco oil is (1835) quoted at from £1 9s. to £1 13s. per cwt.

Husk or Fibrous Covering of the Nut.—To remove the husk an iron spike or a sharp stake of hard wood is fixed in the ground. The nut is forced by a sudden impulse upon the point, which passes through the fibres, by which means the rind is separated from the shells. In this manner a man can clear 1,000 nuts daily.

Uses of the husk.—The husk of coconut is in India much employed as fuel, to clean and polish furniture, to scour the floors of rooms, &c., &c. It is also used by gardeners for separating trees by layers in the following manner: two sections of a husk are bound round that portion of a tree which it is intended to separate from the parent stock, and they are kept moist by suspending a coconut shell over them filled with water, having a very small orifice, so as to permit the water to pass through in drops. By this means the development of roots is promoted in the husk, when the branch becomes an independent plant. In the Comora Islands, according to Sir Thomas Roe, the inhabitants used coco husks as towels, boiled for a short time in a solution of nitre, the husk used to be much employed in India as match.

nufacture of Coir, Kpir, or Coira.—The husks of coconuts not com-
y ripe are chiefly employed for this purpose. They are soaked like
three or four months in a tank, pond, or stream of water; they are
ashed and beaten with a block of ebony upon a stone. After being
he fibrous matter is again beaten until the interstitial substance is
tely separated from the purely fibrous portion of the husk. Subtly it is rubbed with the hand and pulled like hemp. It is then spun
rns or sinnet for the purpose of being manufactured into cordage
izes, or applied to the other uses. The fine yellow colour of coir
that the husks had been steeped in clear running water. The
nce of coir depends chiefly upon its being effectually cleaned from
neous fecula with which the capillary filaments are connected. Dr.
obtained six pounds weight of coir from the husks of forty coconuts.
's *Travels in Brazil.*) Forty nuts yielded from an experiment lately
n London 105 ounces or 6½ lb. of fine coir.

scellaneous Uses of Coir.—Coir is much used in India to stuff mat-
, saddles, cushions for couches, &c., &c. It is also employed to make
and brushes to white-wash houses. It is universally used in India
natives as *oakum* in the construction of their boats and ships. Coir
more with water than hemp, and therefore, it makes better oakum
d ropes. Nets for catching fish are made of it, as also a coarse kind
. Door mats of an excellent quality manufactured of coir are now
l about the streets of London and Edinburgh. In Java coir is
l into a rope of a loose texture, which is called by the Javanese
apie (fire rope), which continues ignited for a long time, and is on
eount used for lighting *Cheroots* (cigars). The Dutch gentlemen in
a usually travel with a tallie apie suspended under the carriage, for
rpose of having it always at hand when wanted. Tallie apie is also
s rope match for artillery. Coir has lately been introduced into
ountry by a gentleman who resided many years in Ceylon, as a
ute for horse hair, straw, flock, cotton, *Zostera marina*, and other
nces which have been employed for mattresses, pillows, cushions,
t can be furnished at much less than half the price of horse-hair,
s elastic property approaches nearer to that substance than any
which has yet been discovered. It is not liable to get into knots,
ock, cotton, or tow, and it is much less injured by damp or moisture
y of these substances. Coir might be with advantage employed as
titute for horse-hair, flock, straw, &c., especially in soldiers' bar-
seamen's hammocks, and also in hospitals, lunatic asylums, prisons,
t ships, and other large dormitories. Might coir not be manufac-
nto paper?

ir Cordage.—This article has for time immemorial been universally
yed in India and the oriental archipelago in the manufacture of ropes,
ways without the use of tar. It is much used for connecting or
together the planks or timbers of boats; the Massaula boats, for
le, which, on account of their elasticity, resist the force of the heavy
the Coromandel Coast infinitely better than the best English-built
"The ship wherein I came out of India into Portugal had no other
nor cables, nor any such kind of stuffee, but such as were made of
Cocus, called *Coir*, which continued very good, saving only that we
orced over fourteen days to wash our cables in the sea, whereby
erved as well as cables of hempe." *(Linschoten).* A similar mode of
wing coir cables is adopted in the present day. Until chain cables
ntroduced, coir cables were generally used in the ships which navi-
the Indian Ocean, and perhaps they are still much employed. At
t coir cables are employed for mooring ships in the harbour of Port
Mauritius. Coir cordage, when properly prepared, is pliable, smooth,
and elastic; it is very well suited for running-rigging, more especi-
ere lightness is deemed an advantage, such as top-gallant studding-
eet, &c. On account of its elasticity, seamen used to consider it not

well fitted for standing rigging, but a plan has recently been adopted for the purpose of remedying the defect, which consists in stretching the rope, and, in the language of seamen, serving it with tarred cloth and spun-yarn. Coir cordage is so much better adapted for tropical climates in the opinion of many Captains of ships that they receive a set of coir rigging when they reach the tropical seas, which they use until they return to a temperate climate. Dr. Roxburgh, in his observations on the comparative strength of English hemp and other vegetable fibres, states that he found hemp rope and coir rope, when large, to be respectively as 108 to 87 in strength, and when smaller as 65 to 60. In the same paper (*Transactions of the Society of Arts*, vol. ii.) he says: "Coir is certainly the very best material yet known for cables, on account of its great elasticity and strength." Coir cables are said to be greatly preferred to hemp cables in India. They are exceedingly buoyant and strong, and by being very elastic they stretch considerably without straining a vessel; so much so that, with a cable of 120 fathoms, a ship will retire or give way sometimes half its length when opposed to a heavy sea, and instantly shoot ahead again. Ships occasionally founder at anchor with hemp cables, which might have been saved by means of elastic coir cables. They are also not so liable to rot or to exhale moisture as hemp cordage.

Trade in Coir.- With the exception of the Maldive Islands, Ceylon is the only place which exports coir in large quantities. "It is supposed that in the Dutch time 3,000,000 of pounds of the substance were manufactured in the district of Colombo, Matara and Point de Galle." *(Bartolacci, Commerce of Ceylon.)* I presume the author means that the above quantity was manufactured annually. Coir is commonly exported in coils of about 390 lbs. weight and a quantity of pounded salt is usually sprinkled upon it. In 1825, Ceylon exported 5,788 coils of coir, equal to 2,260,309 lbs. valued at £10,000 being a little more than 1d per pound. Manufactured coir such as cables, hawsers, &c., may be exported, duty-free, but loose coir is liable to an export duty of 6d. per cwt. Coir rope, upon being imported into the United Kingdom, pays a duty of 5s. per cwt. Old rope fit for mats only is admitted upon paying 5s. per ton. In the Tonga Islands coir is prepared in considerable quantities, which is exported to New South Wales, where it is, according to account, sold at £40 per ton, to be manufactured into rope. The word *coir* seems to be an Indian appellation for the prepared husk of the coconut. *Kohu* is the Sinhalese, and *Kowra* the Tamil name of this substance. In the Tamil language *cowcree* means a rope or cord, so that coir may be derived from the Tamil word for a rope, which it resembles in sense as well as in sound.

Uses of Coconut Shell.—"The husk being taken off, the shell serveth for many uses, as to make ladles with wooden handles, and also certain little pots, which being fastened to a stick, they do therewith take and lade water out of their great pots; they make thereof also small vessels to bear wine in, when they walk into the fields, and a thousand other things." *(Linschoten.)* A coconut shell forms the most important part of the smoking apparatus of the natives of India. Half full of water, with two hollow bamboos fitted into holes bored into it, and an earthen *chilum* to contain the tobacco at the top of one of them, it forms their *hubble-bubble* or *hukka*, which is an indispensable companion to the Mussulmans in India. Coconut shells and gourds are only vessels used by the natives of the Society Islands.

The Venah, Vina or Been, or musical stringed instrument of the guitar kind, much esteemed by the Sinhalese, is in part constructed of two sections of a coconut shell, each of which is covered with the skin of a lizard, and perforated below. Coconut shells are sometimes manufactured into beads for rosaries. The use of beads in devotion

to the Hindaos along prior to our era. Brahma is represented monuments as counting a rosary of amber, at each recitation of God. (*Thomson, Etymons of English Words.*) Water bottles ade of them, some of which will contain a quart. The shell hin, and when well prepared it is in some degree translucent. minary measure to this preparation, the nut is buried under a few months, during which period the membrane which natural orifice at the base falls out, and the kernel be- ened, so that the cavity of the shell may be easily emptied. ups occasionally appear on the tables in this country as ns; when well polished, they resemble, as old Gerard says: d horne." Excellent cups are made of them in India, by bbing off a portion of the base or lower end upon a stone. much use is made of the shell of the double cocoanut, es- y Fakirs.

onte Video, in South America, the ladies drink an infusion (Paraguay tea) from highly ornamented cocoanut cups. They he tea from the cup by sucking it through a long silver tube. non ladle used in great part of India and Brazil is formed of a nut, to which a long wooden handle is fixed. In America, n have given a name to the instrument, for ladles made of called *silver cocos*. By the inhabitants of some of the oriental hey are employed as a measure for ascertaining the quantity of and fluid substances. Their capacity is known by the number s (*Cypræa moneta*) they will contain. Hence there are cocos of 000 cowries, and so on. They are used as fuel by the Indian en to heat their smoothing irons, and when converted into char- mixed with lime they are employed to colour the walls of houses.

le in Cocoanut.—The export trade in cocoanut is nowhere carried xtensively as in Ceylon. In 1825, this island exported 6,933,552 iefly to the peninsula of India, which were valued at £7,561, little more than one farthing each. The export duty is 4d per ie Maldive Islands export a considerable quantity of cocoanuts as the Nicobar Islands. Most of the country ships which are bound t from either the Malabar or Coromandel Coast of India touch at ter islands, in order to procure a cargo of cocoanuts. The captains purchase them at the rate of four for a tobacco leaf, and 100 ard of blue cloth. One bottle of cocoanut oil was at the same exchanged for four leaves of tobacco. Cocoanuts imported into the Kingdom used to pay a duty of 5s per 120, but in 1882 the duty duced to 1s per 120, when imported from a British possession, and cent. *ad valorem* when from the possession of a foreign state. In ndon Market the price of cocoanuts is from 10s to £1 10s per 120. In the price of seed nuts various from 18s to £1 4s per 1,000.

ddy, Sura; Meera. Sweet Juice.—The proprietors of cocoanut planta- in the peninsula of India, and in the Island of Ceylon, instead leeting a crop of nuts, frequently reap the produce of the trees tracting sweet juice from the flower-stalk. When the flowering h is half shot, the toddy-drawers bind the stock round with a young ut leaf in several places, and beat the spadix with a short baton of . This beating is repeated daily for ten or twenty days, and about d of that period a portion of the flower-stalk is cut off. The stump begins to bleed, and an earthern vessel (chatty) or a calabash is nded under it, to receive the juice, which is by the Europeans called . The indigenous inhabitants of the Malabar coast and Ceylon call *ra*, and when drawn in a particular manner for being converted into ry it is denominated *meera*. The word *toddy* or *terry* is a corruption e Sanscrit word *taree*, liquor drawn from a palm tree. *Sura* in all derived from the Persian word *shir*, liquor or juice or the

Arabic word *shorab*, wine, hence also our word *shrub* and *sherbet*; *meera* in the Sinhalese language means sweet juice.

A thin slice is taken from the stem daily, and the toddy is removed twice a day. A coconut tree frequently pushes out a new *spadix* once a month, and after each spadix begins to bleed it continues to produce freely for a month, by which time another is ready to supply its place. The old spadix continues to give a little juice for another month, after which it withers, so that there are sometimes two pots attached to a tree at one time but never more. Each of these spadices, if allowed to grow, would produce a bunch of nuts from two or twenty. Trees in a good soil produce twelve bunches in the year, but when less favourably situated they often do not give more than six bunches. The quantity of six English pints of toddy is sometimes yielded by a tree daily.

Uses of Toddy. Linschoten says, "Sura is very pleasant to drink, like sweet whey, and somewhat better." Toddy is much in demand as a beverage in the neighbourhood of villages, especially where European troops are stationed. When it is drunk before sunrise, it is a cool, delicious, and particularly wholesome beverage, but by eight or nine o'clock fermentation has made some progress, and it is then highly intoxicating.

The "strong drink" of the Old Testament was perhaps in some instances toddy extracted from the date palm. Dr. Mosely, in his Treatise on Sugar, states, that the Hebrew word *shecar* is in our English Bible every where rendered "strong drink," and in the Latin paraphrase it is denominated *sisera*, which by being corrupted into *sidera*, is the original of our word *cyder*. We are informed by St. Jerome, that *siker* or *shecar* was used to designate any kind of exhilarating or intoxicating liquor. *Shecar* seems to be nearly allied not only in sound but in the quality of the article designated to the Persian *shir*, and the Tamool *sura* (toddy.) The writer of the article on *coconut tree* in one of the Cyclopedias now in the course of publication has made a singular mistake with regard to the Anglo-Indian name of a coco plantation. He says, "The place where this drink (sura) is manufactured, is called by the English a "toddy tap," and where any one may be supplied with a draft on very low terms."

Yeast.—Fermented toddy is usually used by the bread-bakers in Ceylon as yeast, for which it is said to be an excellent substitute. It has been observed that sea biscuit baked in India with toddy yeast keeps longer, and is superior in quality to biscuit which is baked in Europe.

Vinegar. To prepare vinegar, the required quantity of toddy is put into jars, which are partially covered. After the lapse of a few weeks, the toddy is strained and returned to the jars; a few pods Chili pepper (*Capsicum frutescens,*) and also of the horse radish tree (*Hyperanthera moringa*) are added to it. In the course of four or five weeks, the toddy is converted into excellent vinegar, which is much used in Ceylon for picking a great variety of vegetable substances.

Arrack.—The principal use which is made of toddy in Ceylon is to convert it into ardent spirits. From toddy arrack is distilled in the same manner as brandy from wine, by means of a common still, and, according to Bartolacci, it yields by two distillations about one-eighth of ardent spirits, of the same strength as good brandy 25 under London proof. Toddy is said to be very similar in strength inasmuch as the same quantity of arrack may be distilled from sweet juice obtained from very different soils. It is also alleged by the Ceylon distillers, that they obtain the same quantity of arrack from new toddy as from that which has been kept for several days. At the end of twelve or fourteen days it is so acid that it cannot be distilled into arrack. With respect to the quality of arrack in the sixteenth or seventeenth centuries, I may quote Linchoten

and Dampier, "This sura," says the former, "being distilled, is as excellent *aqua vitæ* as any is made in Dort of their best Rhenish wine, but this is the finest kind of distillation." The Arrack, says Dampier, "is distilled from rice and other things in the East Indies, but none is so much esteemed for making punch as the sort made of toddy, but it must have a dash of brandy to hearten it, because this arrack is not strong enough to make good punch of itself." The strength of arrack is ascertained in Java by the following process: A certain quantity of the spirit is burnt in a saucer, and the residuum is measured, the difference between the original quantity and the residuum gives the measure of the alcohol lost. The word arrack (which seems to be derived from the Arabic word *araq* or *arak*, juice or spirit,) is employed synonymously with ardent or distilled spirits over the Eastern hemisphere. In Dalmatia arrack is drawn from the husks of grapes; in Tartary from sloes and dog-berries, plums, &c., and also from milk; at the Cape of Good Hope from *brandyewynbusch*, (*Grewia flava* or *orientalis*); in Ceylon from coconut tree toddy; on the Continent of India from toddy, molasses, jaggery, rice, and even the bark of some trees, hence the term *puttah* or bark arrack, in Batavia, China, and Loochoo, where the word is corrupted into *lackie*, from rice, sugar, &c. Arrack is also distilled from mahwah flowers (*Bassia longifolia.*) Mahwah arrack may be procured in some parts of India at the rate of an English pint for one penny. Arrack of an inferior quality, from whatever substance it may be extracted, is commonly denominated *pariah arrack*, the word *pariah* being used all over India as a degrading epithet. The English word *grog* is also derived from *arak*, and *punch*, which is commonly supposed to be a corruption of *potus nauticus*, Mr. Thomson thinks, may be derived from the *Sanscrit* words *pan*, beverage; and *cheene* sugar,—(*Etymons of English Words.*) Mr. Booth says, "The name punch is given on account of the *pungency* of the lemon, the juice of which enters into the composition of the beverage." (*Analytical Dictionary.*)

Trade in Arrack.—Ceylon is perhaps the only place in the world where a large quantity of toddy-arrack is manufactured for exportation. The mean annual quantity exported from this island for eight years, or from 1806 to 1813 inclusive, was 5,200 leaguers each containing 150 gallons, or 780,000 gallons. The chief part of this quantity was exported to the presidencies of Bengal, Madras and Bombay. Arrack used to be, and perhaps is still, issued to the European troops in India, as part of their regular diet; and the seamen belonging to the Royal Navy in the Indian seas are supplied with this spirit in place of rum. In 1813, the Madras Government imposed an excise duty of 10 per cent. upon Ceylon manufactured spirits. Notwithstanding this very high duty, Ceylon has continued to export a considerable quantity of arrack, chiefly to India. In 1825, it amounted to 611,218 gallons, which was valued at £21,500 or about 8½d. per gallon. Arrack is liable to an export duty of 18s. per leaguer of 150 gallons.

Preparation of Jaggery.—Jaggery, which is a coarse kind of sugar, is obtained by evaporating the watery part of the sweet juice (technically called in Ceylon *neera*,) which exudes from a section of the flowering spadix. A clean dry calabash or earthenware chatty is suspended under the stock, into which a few pieces of the bark of the *holghas* (*Valeria Indica*) are thrown, and generally a small quantity of *chunam* (lime). It is alleged that the bark has the quality of fining the neera, and of promoting the formation of the sugar or jaggery. Quick lime will no doubt absorb any acidity and thereby tend to prevent fermentation. A good healthy spadix will yield from three to six English pints of sweet juice in 24 hours, namely four pints in the morning and two in the evening. The sweet juice is filtered immediatly after it is drawn through *matulla*, and boiled over a slow fire in an earthen chatty on the same day it is collected. When the juice has been boiled for about two hours a small quantity is taken out and tried. If it has been sufficiently boiled, it will form into a ball

between the fingers, but if it do not cohere, the evaporation must be continued. When sufficiently boiled, it is poured into sections of coconut shells, in which it soon cools and becomes solid. Each loaf or cake of jaggery is seperately tied up in pieces of the dried leaf of the plantain tree (*Musa paradisiaca.*) One gallon of meera will yield about 24 ounces of jaggery. The word jaggery is probably a corruption of the Sanscrit word *Sakar*, sugar, and hence also the Arabic *shukar*, the Latin *saccharum*, the French *sucre*, and the English word sugar.

Uses of Jaggery. Jaggery is almost the only sugar used by the indigenous inhabitants of Ceylon, In Java, and in some parts of the peninsula of India, it is converted into spirits by distillation. Cement or mortar mixed with water, which contains from 15 to 20 pounds of jaggery, dissolved in every 100 quarts, acquires great tenacity, and takes on a very fine polish. In Madras and some other parts of India the flat tops of the houses are covered with this cement. It is much employed to cover columns, as also to form the floors of rooms. Floors of this kind are sometimes stained so as to resemble marble. It is said that jaggery cement has succeeded very well in Holland.

Trade in Jaggery. Ceylon exports a considerable quantity of this sugar and I believe chiefly to the peninsula of India. In 1825 there were exported from this island 309,955 lbs. of jaggery, the estimated value of which was £4,916. By the regulations of 1813, the export duty levied upon jaggery was 10 per cent. *ad valorem.*

Medical Uses.

Roots. A decoction of the roots of this tree is considered by the native doctors in India as a very useful remedy in intermittent fevers. Ginger and jaggery are commonly added to the decoction, and the mixture is denominated a *cusemeni* by the Indo-Portuguese. When mixed with a little newly prepared oil, the decoction is much employed as a gargle.

Matulla (coconut tree lint.) This soft downy cloth-like substance is used in India for stopping blood in cases of wounds, bruises, leech bites, &c., for which purpose the finer parts of it are well adapted. The Tamool name of this substance is *Panaday.*

Toddy. Europeans, especially delicate females in India, who are apt to suffer much from constipation, find a cupful of fresh toddy drunk every morning at five o'clock, one of the simplest and best remedies they can employ. (*Ainslie, Materia Indica.*) Cæsar Fredrick, who travelled in India as a merchant about the year 1563, avers that toddy "has most excellent virtues, in so much that if a person were rotten with disease, and drinks abundantly of it, he shall become whole, as I have seen proved. For when I was in Cochin, the nose of a friend of mine began to drop off, on which he was advised by the physicians to drink toddy day and night as much as he was able. He did as he was directed, and I have seen him since perfectly sound and well coloured." Now-a-days we have not such confidence in the virtue of toddy as to suppose that it would renovate a "rotten" nose.

Flowers.- The expressed juice of the flower mixed with new milk and sugar is much recommended as a demulcent. It is also said to be a useful remedy when mixed with fresh oil in local complaints.

Water.— The whey-like fluid or water of young coconuts is recommended by various authors to the fair sex as an excellent cosmetic.

Oil. Coconut oil is used as a substitute for olive-oil, in the composition of pharmaceutical preparations, such as ointments, plasters, &c., and it is found to succeed extremely well, except in the composition of plasters, where a union is required to take place between oil and the semi-vitreous oxide of lead. In the laboratory at Colombo it is employed

in a number of the preparations where olive-oil is directed to be used by the pharmacopeias. It is alleged that coconut oil divides mercury better than any other oil.—(*Journal de Pharmacie*, Tom ii. p. 101.)

Ablution or frequent bathing of the body is a religious ceremony, which is rigidly observed by the disciples of every form of faith in India. A large portion of the natives of India bathe almost daily. After coming out of the water, the hair, and frequently all the body, is well rubbed over with coconut oil. Sometimes the oil is mixed with the powder of sandal wood and other odoriferous substances. Coconut oil mixed with turmeric-powder is much employed by the natives of Ceylon and the South Sea Islands for anointing the body in wet weather and during sickness. Frequent inunction with coconut oil is alleged to be very useful in preventing disease of the skin among persons who are often exposed to the ardent rays of a tropical sun and the asperation of sea water.

The very great importance of the cultivation of the coconut tree in Ceylon may be inferred from the amount of duties levied on its produce, as will appear by the following statement:—

Schedule of duties levied on the produce of the coconut plantations in Ceylon, average of three years, 1827-29.

	£.
Distillery of Arrack	3,644
Retail of do	24,975
Export of do	3,136
———— Coir	153
———— Jaggery	162
———— Copperas	1,539
———— Coconuts	1,551
———— Coconut Oil	413
	35,573

THE PINK COCONUT.—We have before us a young coconut whose outer husk presents no unusual appearance, but a cut discloses a bright pink inner husk. The nut is from a tree growing on Crow Island near the mouth of the Kelani river, which is said to have been planted by the late Mr. H. M. Fernando, one of whose sons tells us that the Sinhalese believe that the husk has some medicinal properties. The plant is said to have been got from Jaffna. Can any of our readers give us any information regarding this rare and beautiful coconut? "Examiner." [A pink color at the ends of young coconuts we have observed. The late Dr. Gygax extracted a pink dye from the coconut husk, to celebrate which event, Mr. Taylor of Batticaloa wrote a poem in the *Observer*, "Couleur de Rose."—*Compiler*.]

THE PINK COCONUT.—The pink coconut referred to above is called *ran-tœmbili* by the Sinhalese, probably owing to the pink colour of the inner part of the husk at the upper end of the nut. The colour does not go lower down the nut than three or four inches. There were a few years ago (and likely there are still) a couple of trees bearing this description of nut, in the village of Payyagala of Kalutara district, about three miles and a half south of that town, and near the high road to Galle. Externally the nut has the appearance of an ordinary drinking coconut, but of a slightly lighter green, and smoother surface. To a careless observer these distinctions would not be apparent. The Sinhalese, I have heard, believe the *liquid* in the nut, and not the *husk*, as the "Examiner" has it, is possessed of some medicinal properties, and use it in the preparation of some of their decoctions. I am of opinion that this *ran-tœmbili* is not a distinct variety of the coconut, but an accidental growth, or what may

perhaps be technically known as the *sports* of nature. Now there is another description, with a green husk too, known as the *pœni-pol*, or honey, or sweet coconut, the flesh of which, adhering to the inner side of the shell, is as sweet as if it was preserved in sugar, whether the nut be tender or ripe. This too, I believe, is not a variety, and like the other, a mere caprice of nature; or to be probably accounted for, in the former case, by some red colouring matter in the soil where the trees stand, or some sweetening substance in the latter case: for, how is it then that these two descriptions could never be propagated from seeds taken from a well-defined tree? The Sinhalese have often assured me that the experimental plant produces nothing but the ordinary green coconut. Now the way to test the fact, that these two are not varieties, is, I believe, to mention the *rat-tambili*, our beautiful orange-coloured king-coconut and the *nauusi*: the former yielding a delicious, cool, refreshing and health-giving drink, and the latter not only affords a cool refreshing beverage, but the larger part of the *husk*, the upper part of which is as tender as carrot, is a pleasant food for the natives, and both of which are well established varieties. It would be interesting to know what W. F. has to say on this subject. *Cor.*

THE COCONUT TREE AND ITS USES.

To the Editor of the "Ceylon Observer."

SIR, The coconut tree belongs to the tribe of palms. It is said, and truly so, that of a coconut tree a ship can be built and laden too. It grows to the height of 60 or 70 feet from the root, and the trunk gradually tapers, and almost at its submit it spreads out into what are called branches, and each leaf is divided in the centre by a thin woody rib which is called the mid-rib. The leaves are useful both in their fresh and dried states. The dried leaves are, after soaking for a short time in water, separated from the branch and dried and plaited, they form a plaiting of leaves woven into each other, and are called cadjans; these cadjans are used for covering houses, fences, and roofs of country vessels. The leaf and branch or leaf stalk undivided and plaited with one another make good substitute for tats, and are cool and refreshing when fresh. The trunk of the tree at its lowest part is six or eight feet in circumference: when divided into two, it is used at gutters and in some places as rafters, but is not equal in duration to the palmyra rafters. From the bottom upwards there are concentric rings which mark the place where the old leaves were attached. The flowers are generally enclosed in thick horny-looking but fleshy cases which are called spathes; they are in clusters on each side of a stalk. From the spathe and flower a liquid substance is obtained resembling watery milk which is called toddy. This is sweet and refreshing when fresh, but when exposed or kept too long become sour and intoxicating. Spirits called arrack is obtained from the toddy in such large quantities as to afford a revenue to Government and an article of trade. Of the sour toddy vinegar is made; from the sweet toddy collected in large quantities boiled and evaporated a sweet substance is obtained which is called jaggery. The fruits grow in clusters: some varieties of them are comparatively large; when tender or fresh plucked, the nut has a green fibrous coating under which are fine fibres of a reddish yellow color which cover the shell. The shell is hard and woody; it encloses the white fleshy kernel and some water. The outer covering of the coconut, although generally cast away, when dried, may be used for fuel; the underlying fibres when washed and cleaned and separated are called coir fibres. The fibres are used for a variety of purposes; they are made into coir rope of different thickness and strength; they are made into mats, rugs and brushes, and have been plaited and made into hats and bonnets; they are also used for cushions, mattresses and many other things. The shell

can be divided into two and used for ladles, cups and drinking vessels; sometimes only the top piece is sawn off and graven with varieties of designs. The kernel is a white and comparatively soft substance which is found inside the shell; in its early stage it is like jelly and can be easily scooped out and eaten; it is cooling and refreshing. In an advanced stage it is harder and may be scraped; in this stage it is used in making cakes; when boiled with sugar it is called "chuncha" or "chuncharam" in Portuguese. This is put into pancakes and rolled and is called "throothas." When still more hardened and matured it is scraped out, and milk is expressed out of it which is sweet and of a thicker consistency than cow-milk. The milk is used for composition curries and forms a nice gravy when boiled together with curry stuffs, etc. It is largely used for this purpose by the people of India and Ceylon. When boiled and evaporated, a fine clear oil is obtained which is used as a hair oil and is the best for improving or promoting the growth of hair; it makes hair soft and glossy. The refuse of the scraped coconut makes very good food for poultry. The coconut when allowed to dry to some extent is an article of trade and exportation and is called copperah, and the oilmongers extract large quantities of oil, which is used for lighting purposes. It is extracted by a rude kind of mill called chekku, made of wood and worked by bulls. The refuse after being extracted comes out in large cakes and is called poonac, which is used as food for animals and may also be used as manure for trees.

By way of recapitulation it may be stated that a vessel may be built by layers of rafters both for the ribs and sides of the hull of the vessel. The interstices or seams may be filled by coir fibres, then caulked and painted. The floor of the deck may be laid with rafters and these also caulked and painted. The mast may be made of the well-seasoned trunk of the coconut tree. The rope and hawsers may be made of the fibres; the sails may also be made of the same. Then the vessel will be from stem to stem made entirely of the coconut tree. It may be laden with following:—Coconut rafters, coir yarn, mat, rugs, brushes, and coconuts. It may also be laden with arrack, jaggery, copperah, coconut oil, poonac and cadjans. So the vessel will be actually built and laden with the coconut tree itself. There are several kind of cocoñut: the ordinary "nawasi," of which the fleshy covering of the kernel is tender and may be eaten, is of a sweet taste: the king coconut, the outer skin of which is white, is of two kinds, the large and small size; then there is what the Tamils call "suriya kavelle" (sun-faced) —if the stalk-end of the surface of the coconut is cut, it presents a beautiful red appearence; this is supposed to be caused by the face of the sun, but how it is so is not known—the native use this kind particularly for medicine. Then there is the small hard kind which the natives call "pora tengai," the shell of which is very hard, and they use it for breaking against each other on their New Year's festival, which is about the 12th of April. Then there is the dwarf coconut tree which looks very ornamental, and the Maldive is also another kind of coconut.

SILEX.

COCONUT CULTIVATION IN CEYLON.

(From the "Ceylon Examiner.")

The July number of the *Tropical Agriculturist* opens with a very interesting and highly-instructive paper on Coconut cultivation by a veteran planter, "W. B. L." The paper is perhaps not as full with details, modes of culture, &c., as another paper on the same subject which bears evident traces of the same pen, and written nearly a decade back. To those engaged in coconut cultivation, I would advise the careful perusal of both papers, as likely to afford many useful hints. I cannot more than give a slight sketch of the last essay. The best soil for coconut is said to be alluvial loams subject to periodical inundation. The next brown loams, after which comes sandy loams. Solid cabook and stiff clays are to be avoided. The

nearer the land approaches the level, the better is it for coconut cultivation. Nurseries must be made eight months before the plants are wanted, with 50 per cent more nuts than the number of plants necessary. Those that do not germinate within 5 months are to be rejected as likely to be laggards all their life. The careful selection of seed-nuts is of the first importance. The trees from which the nuts are taken should be mature, healthy and in heavy bearing. The nuts must be thin-skinned and ripe without being dry. Considering the length of life of a coconut tree, it is really a pity that no attention whatever is paid to the selection of the seed-nuts. Any and every nut one comes across is put in the nursery, or plants are bought from anywhere. The beds, we are told, are to be 4 feet wide, and made by digging the ground 6 inches deep and placing the nuts with the stalk end upwards. After experience, I have a decided objection to placing the stalk end upward, and for this reason, that there is a depression at the stalk, which is directly over the "eyes" of the nut or the seat of the germ. At the depression the husk is not, as elsewhere, to a certain extent impervious to moisture. All the moisture taken in at the depression works its way downwards, and by the action of the sun causes a certain amount of fermentation that destroys the germ. If the nuts are placed sideways, these objections are overcome, and the germ is kept constantly moist by the water within the nut—which is not the case in the other position—and offers greater inducement to speedy and successful growth. It strikes me that the information now given to fill up only the spaces between the nuts with soil does not quite accord with what was written by the same writer a few months back, when theorizing on the depth the seed of the different palms ought to be put in the ground to ensure successful growth. In that communication, which was one of a series of monthly reports of a new products estate, it was said that cocoanuts must be planted with six inches of soil above it. It happened that I had just about that time formed a coconut nursery in the usual style, that is with the top of the nuts peeping out. I was asked why I did not follow the new plan by one interested in the nursery, and as his wishes seemed to lie in the newly-suggested direction, I took no steps to remove from the nuts all the earth that had been washed over them—for, remember, my nursery was below a slope. What was the result? About 90 per cent of the nuts rotted and refused to grow; so much for theories, and for leaving the well-beaten track of experience to follow the attractive paths of theory.*

To return to the essay. The lining must be in squares 25 ft. each way. The holes must be cut with the first rains in March, and must be 3 ft. cube and be half-filled with the top soil and ashes. If this were always followed, we should certainly have strong, healthy plantations, giving good crops without extraneous aid. Instead, we find the general practice is to cut, or which is thought to amount to the same thing, to give orders to cut holes 18 inches every way, into which the plants are put with no attempt to give them a start by putting a little of the rich surface soil and ashes round the nuts. And this is the universal practice among those who should know better. Fencing your clearing to keep out cattle is said to be the next step, and a live fence is recommended of either *erandu* or *kaju*. A paragraph is devoted to the discussion of secondary crops on coconut clearings, and much speculation is indulged in. The writer has no objection to any secondary crop which covers the cost of

* Will not placing coconut on their sides in the nursery be a departure from the well beaten track of experience? Yet it would be wise to try it on a small scale. The failure of 90 per cent would be conclusive against the experiment, assuming that the nuts were well ripe, and that silt washed down a slope is as useful as fresh soil. Again, may not the position of the nursery have given it too much moisture? We wish coconut planters more often published their experiences for the common good.—ED. "EX."

labour, pays for fertilizers in the place of what it removes, and leaves the owner something besides. I venture to believe he is not singular in this, as this object is the sum total of the aspiration of every reasonable cultivator. The usual secondary crops of the goiya system do not, it is said, meet those conditions, and kurakkan, it is said on what authority we are not told consumes a vast quantity of phosphates and nitrates. I quite endorse the writer's suggestion that it would be better to grow chillies in the place of kurakkan, manioc and sweet potatoes: for chillies do not meet a local but a general want. Whether a chillie crop is more profitable I am not quite sure, for it must be borne in mind that chillie cultivation is garden cultivation, which for its success requires that the soil be constantly hoed and kept free from weeds. This means the expenditure of a vast amount of labour and energy constantly, of which the average Sinhalese is incapable or averse to, unless stimulated by the prospect of a daily wage when it will be found not to pay. Every one will be inclined to agree with the writer of the essay that if a proprietor has the capital (I am inclined to add to capital. Will and Energy, for we see capital by itself never used aright), he can put his land to more profitable use than to give it to goiyas. Croton and arnatto are suggested. The former yields a very powerful purgative oil used in very small doses and in exceptional cases. Increased supply will bring down the present high prices. As for arnatto, the cost of detaching the seed from the outer covering is very large and will swallow a large portion of the profit.

Amongst the enemies of the coconut tree, the wild pig has the first place. Not only because he is the most destructive to a young plantation I suppose, but because he is about the earliest enemy the plant has to contend against. The white ant comes next, and its ravages are simultaneous with those of the pig. Arsenic is said to be the best preventive, and the difficulty of applying it in minute doses is supposed to be overcome by filling a tub with water and adding a quarter pound sugar and two grains arsenic for every gallon of water and flour sufficient to make the mixture assume the consistency of whitewash. Each plant is to be dipped in the mixture, it being stirred the while and left in the sun for the outer coating to dry. The white ant, it is believed, cannot get at the nut without partaking the arsenic. It is here assumed that the coating of the mixture will resist the action of water, for, be it remembered, that planting usually is done in the S.W. rains. If arsenic be soluble in water, I am inclined to think the mixture will be more effective without the sugar and flour, and if the plants, *i.e.*, the husk, be allowed to imbibe a portion of the mixture. I have heard alum mentioned as a specific for white ants. If the plants are allowed to imbibe alum and water with a dash of kerosine it may be good. To those with coconut plantations on the sea-borde, I would suggest the trial of a plan of a neighbour of mine. He filled a tub with sea-water and dipped his plants in it for twelve hours I believe. The remedy has the merit of possessing manurial value as well. Cattle, as an enemy, comes next in order, and is, I think, as destructive as any enemy, when it pulls out the toothsome cabbage or heart of the plant for a dainty mouthful. There is an end of the plant after that. Black beetle comes next, but it is, I believe, seldom or never that a plant succumbs to its attack. It is usually fished out with a barbed wire; but for its extermination the heroic remedy of hunting every "dunghill, every accumulation of decayed vegetable matter or rotten tree" is suggested. This will involve a never-ending, and therefore very expensive, hunt, with very dubious results. The last and least in size, though not in its destructive powers, comes the red beetle. It is placed last on the list because it is perhaps the enemy of the mature more than the young tree. It is said to have no alimentary apparatus in its perfect state, its sole business then being propagation. It deposits its eggs wherever it finds a slit in the stem of the coconut tree. The resulting grubs work their way into

the heart of the tree. This work of destruction done, and when the term of existence as a grub is drawing to a close, they withdraw near the rind and envelope themselves in a cocoon made of that part of the tree they have destroyed and await transformation. We are told that the coconut tree is in danger of this enemy from the time it perfects a stem till it commences to bear, although I have had trees attacked long after they have commenced to bear fruit and yield crops. The cause generally is traced to the desire of planters to trim their trees to give them a decent appearance. This necessitates the pulling-off of all decayed branches and the exposure of the tender stem to the sun, which causes it to be split, and there the beetle lays its eggs. Occasionally a tree is said to be lost from an accidental wound or a defect in the arrangement of its leaves. Observation has inclined me to the belief that the beetle does not, as a rule, go from tree to tree seeking an accidental wound or a slit in the tender stem where it may lay its eggs. If such a spot be found, it will no doubt be readily used by the beetle as a depository for its eggs, and save itself the trouble of forming one, which it invariably does. There is no remedy, we are told, for an attacked tree but to destroy it with fire. This is generally true, but occasionally a tree can be saved by cutting out a hole in the hollowed part of the tree, scooping out what has been destroyed with all the grubs and beetles it contains, and burning in the hollowed part any substance that will give a dense smoke. Immediately after, fill up the hollow with ant-hill earth and ashes saturated with kerosine and water or carbolic and water. Even this remedy fails except at rare intervals, but the vitality of the tree is impaired after the attack. I regard the red beetle is the most formidable foe of the coconut planter, and as destructive as all the other enemies put together. Means may be devised to circumvent the other enemies of the tree, as they carry on their work of destruction openly to a great extent; but the attacks of the red beetle are insidious, and very often the first intimation of its attack is the drooping head of your very best tree. The attacks of the other enemies of the coconut tree are in their early life, when the loss can be easily repaired by a supply; but this foe attacks a tree after it has escaped every other foe, and about the time you expect to reap the fruits of your labour and patient waiting. You cannot avoid its attacks; but I remember reading sometime back that a pound of salt placed between the topmost branches of a tree, just before the two rainy seasons in the year, is a specific, as the melting salt forms a crust on the stem especially distasteful to the beetles. Now we know that salt dissolves even without coming into contact with water, so that so highly soluble a substance is not at all likely to form a rain-resisting crust even of a few months' duration. The benefit of the application to me is more imaginary than real. I will notice the second part of the essay in another communication.

After a long interval I resume notice of the second part of the Essay on Coconut Cultivation which appeared in the *Tropical Agriculturist* for July. Before proceeding, I cannot but refer to your foot-note to that part of my previous communication bearing on coconut nurseries. Nine out of every ten natives put down their seed coconuts on their side, and very often the tenth one too does it. The system has advanced a great deal beyond the experimental stage, and does away with the necessity for trying it on a few coconuts as you suggest, and the benefit of the system are not theoritical but real. In detailing the advantages of putting

* From the absence of any reference in his last letter to the planting of coconuts on their sides being practised by natives, we thought our correspondent spoke of experiments initiated by himself, but on enquiry the very next day, we found that the practice was very common in the country, and we mentioned the fact in a subsequent issue.—Ed. "Ex."

coconuts on their side in the nursery. I forgot to mention that it allows of the resulting plants being steadied when planted out, by two pegs put cross-wise over it, to overcome the displacement which follows the coconut holes being filled with water.

To resume. The "gratitude of the coconut for fertilizing matter" is exemplified by the robust and green appearance of the trees in the vicinity of habitations. The native accounts for this by the love of the tree for the human voice, and not, we are told, by the manure deposited by the family and their domestic animals. The writer thinks that the lesson to be drawn from this is, that we ought to hasten the profitable period by artificial means. To my mind this is a short-sighted policy. The lesson I learn from the vigorous growth of trees near human inhabitations is the benefit of keeping a plantation already in bearing in good heart to secure remunerative returns.

The usual or goiya system of opening up a plantation is next discussed. The clearing of the land is done without any money expenditure by the proprietor; and in a favourable case, we are told, the land share of the secondary crop covers the cost of lining, holing and planting. I suppose this includes cost of plants as well, as it is said this system gives the owner his land planted free of all cost, except the purchase money and the interest on it. The plantation is then allowed to run into jungle for three years, "when there is the alternative of clearing the jungle or letting it grow on, and finally smother 90 per cent. of the plants, whereas if cleared in the sixth year 50 per cent. will probably be saved." A little complicated this, for we are not told what percentage of plants can be saved by clearing in the third year, nor is the period of time in the expression "grown on" indicated. The exactitude with which the percentages of saved plants by clearing at certain intervals is given, is, I am afraid, not the result of any calculation. In the twelfth or thirteenth year, when the more forward trees begin to bear, the final clearing takes place. By the second period of neglect 10 per cent. more of the plants are lost. For the 10 per cent. alive, 10 per cent. will be in bearing, and "the remainder of all ages downwards"—whatever that may mean. Mark, again, the certainty with which percentages are given, without even the small qualifying word "about." The annual expense of weeding and supplying is given at R12 per acre, and only about the twentieth year will the yield cover this truly moderate cost of upkeep, and even then 10 per cent. of vacancies "*will*" exist. "Thus the cost of bringing coconut into bearing in the most slovenly and desultory manner will be R120, R30 of which will be recouped by produce up to the twentieth year." I fail to draw the same conclusion from the figures given.

The "effects of lantana" are noticed next, and we are told that the above conclusions and figures hold good only if the land is of average quality and the jungle to be encountered indigenous, but if the Lantana has crept into it at the third year, and is not cleared at three years, not one coconut plant will be left at the seventh year. It would have been useful to have been told what percentage of plants would have been saved if the Lantana had be cleared at the sixth, instead of the seventh, year. I wonder if the experience and observation of the planters accord with the deadly powers given to Lantana, and with the statement that "the presence of Lantana in a clearing guarantees the extermination of every other member of the vegetable kingdom that depends on the first eight feet of space (?) for its air, light and sunshine." This statement, which everybody who goes about with his eyes open can refute, stamps the writer as a person of very limited observation. I have known coconut plants allowed to be overgrown with lantana soon after planting, cleared not after three years, but after seven or eight years. To the surprise of

the manager of the estate, he found a large number of the trees with flower spathes and commencing to bear, and not the deplorable sight of all the plants gone.

"Calculations of proceeds" I shall produce in their integrity, as the writer assures us that they give the history of more than one property under his observation during their whole life. "The average yield of average soil under the usual goiya system will be 1,000 per acre—R30. There is R90 to make good, the interest on which at 10 per cent. is R9; The current expenditure is R12, and there is R9 over to be deducted if we value the proceeds at R30. Supposing the annual increase of proceeds to be R5, it will take five years to rub out the R90 that stood at debit in the twentieth year. Thus in the twenty-fifth year, the place is clear, and the annual average income will henceforth be R38 per acre, as long as the price keeps up at R30 the 1,000, and this calculation drops all the back interest in the original cost, as well as on current expenditure; from twelfth to the twentieth year, which, if taken into account, would leave from R60 to R70 to be made before the property was clear of debt." The Island boasts of a few financial experts. It will take the best man of these to correctly solve and tabulate the above very complicated problem. Unprofessionals like myself will, in sheer desparation, feel inclined for suicide or to run *amok*. *Cor.* "Ceylon Examiner."

COCONUT-PLANTING.

AS PRACTISED IN THE LOWCOUNTRY OF CEYLON.

To resume, the calculation of proceeds of a coconut plantation according to the goiya system was last touched upon. The next paragraph gives "another sketch of a plantation that was cleared and planted and allowed to grow into jungle for twelve months. At the end of that period the jungle was "ten feet high," with all the plants, less four, destroyed by wild pigs. One can but conjecture the damage done, as the acreage of the plantation is not given. The proprietor of this plantation, we are told, had much pluck and went to work the next year on a new system. He rooted out all the jungle at an expense of R20 the acre, and planted the land with manioc. The wild pigs fancied the manioc more than the coconut plants, and about 70 per cent were saved. The vacancies were supplied twice a year, yet at the end of nine years they amounted to 10 per cent. During all these years the place was kept in order, and the pasturage was rich. At the end of the fourth year cattle were put on the plantation, but securely tethered against damaging the coconut plants. Before the place was five years old, 10 per cent of the plants had commenced to bear, and seventy-five per cent of the plants treated with cattle manure were in bearing before the ninth year; its further progress cannot be stated as the place has not gone beyond the ninth year. The trees, we are told, that had commenced to bear three years ago will, allowing for all contingencies, yield on an average 80 nuts per tree, or 5,600 the acre, which at R30 the thousand, will give the handsome return of R180. The lucky proprietor of this model plantation, we are told, will not wish it to be known that he has spent over R200 the acre on the place, without the further fact receiving publicity, that by the end of the twelfth year he expects the yield to cover every penny of principal and interest, and give him a very valuable property besides. To which I may be allowed to add, that the proprietor must be a very sanguine man indeed, to calculate yield three years hence with such confidence and nicety. Instinct points to the writer of the essay, who never allows the small qualifying word

"about" to disturb his calculations, and to this sanguine proprietor, as one and the same person. The only manure applied to the property was one-third of a ton of quick lime at a cost of R7·50. The high expenditure was owing to every work being experimental and the soil being rich, which of necessity made weeding, etc., heavy. A portion of this property, which received similar treatment to the rest, but did not receive any cattle manure, is so backward in growth as not to show even stem as yet. This, to me, does not speak much for the soil. Fancy trees nine years old not shewing stem as yet! But they are to receive yearly doses of poonac till they come to the forward plants.

We are next told how an old plantation 21 years old and with a poor sandy soil was treated, and how it responded to the treatment. The largest crop it had given was at the period named, and it averaged 13½ nuts per tree. A new manager assumed charge at this period, and submitted a scheme which added 10 per cent to the annual expenditure. It was at first opposed, but finally allowed. As a first step all the pigs were disposed of, as also one-third of the cattle. The rest were allowed free access to the poonac tubs, and had a roomy shed allowed them, which was daily littered with jungle stuff and ferns from the low grounds on the estate. When the rains commenced, all the manure that had accumulated was carted and spread on the surface of the ground at the rate of 2½ cubic feet to each tree, and dug in with mamolies. Not much could be done in this way, as it would have then 12 years to go the round of the estate, while the effects of the manure last only three years; but, as a result, the average yield per tree went up to 21 nuts in six years. Steamed bones were next used, of which two tons were allowed annually, with the result of the yield running up to 33½ nuts per tree in the eleventh year. The estate next fell into the hands of natives, who allowed the yield to fall to twelve nuts per tree. The whole cost of manuring the 18 years was R1 per tree, and the result over R3, giving a return of 300 per cent on the outlay. We are authoritatively told that if five times the amount had been expended, the results would have been proportionate.

The next paragraph is a small lecture on Chemistry, and tell us that the writer looks upon the cocoanut tree "as a chemical apparatus for turning carbon, oxygen and hydrogen into oil." Plants draw the whole supply of these elements from the air, therefore no quantity of oil removed from a given area of land impoverishes the soil. But to make oil, the cocoanut tree must needs grow, and to grow, it draws from the soil nitrates, phosphates and alkalies. If oil only is removed from a land, and all the other products of the cocoanut tree returned to it, the average yield of oil will never decrease as long as the tree is in health. Introduce outside supplies of nitrates, phosphates and alkalies and the yield of oil will increase and the soil be improved. I trust your readers appreciate this little, simple lecture.

We are next told to "replace fertility removed," which is very good and sensible advice, but the process of calculation is not so easy as one could wish. "Ascertain the average of the fertilizing elements removed in a given number of nuts and set aside such proportion of the price as will replace them." Rather a difficult calculation I should say. The surest way is to manufacture oil and to retain the poonac, but if the crops be sold as gathered, the planter must know exactly how much "nitrate, phosphate and alkalies are in a candy of copperah, and their prices," so as to purchase such fertilizers for application to his land. Beautiful in theory, but difficult to practise. One hundred and fifty pounds of poonac, we are informed, will replace the fertility removed by 1,000 nuts, so that that is the cheapest and best manure for coconuts especially if passed through a cow.

The manure resulting from cattle only grazed on a land does not add to its fertility, but it is of great importance that such manure should be placed at the roots of young coconut plants which do not go far in search for food, as aids to rapid growth and early bearing. The benefit the plants will derive will not be only from the food thus placed within their reach, but the roots will be stimulated to increase their feeding ground. It is more beneficial to give small and frequent doses of manure to a tree than large doses at long intervals. The manure must be buried below the surface. When planting, put in each hole a couple handful of lime and a pound of poonac. A tree cannot be expected to yield two or three rupees annually, unless its constitution is built up. The writer of the essay, whose dicta the above are, will spend fifty cents per tree during the first seven years "in building it up," after which, within four years, it will give a return of three nuts for every five cents of manure used. Mark the confidence and certainty with which results are given. The manure and its price too are known quantities in the calculation. There is no practical limit to the yield of a tree; the writer of the essay is acquainted with trees bearing from 200 to 100 nuts each annually for a series of years, but that is owing to the "individuality of the tree" and suitable soil. The contention of the essayist, which nobody ever did or will question, is that any tree bearing a small crop in any soil, can be made to increase its yield. "A good soil gives a good crop without assistance while a poor one gives a poor return, but the one will respond to manure as readily as the other." Here the essayist delivers himself like a practical planter and not as usual as a theorist; but he has forgotten one little question, which every practical planter who has a regard for his own or his employer's purse will put, before he undertakes to increase the yield of "any" tree on "any" soil—"Will the increased yield cover the cost of inducing it?" That is a safe test to apply to all such undertakings. I am afraid no practical planter will accept the next statement that "the same amount of manure will result in the same addition to the crop, whether the trees to which it is administered have previously been bearing ten or fifty nuts per annum."

The next paragraph deals with "the treatment of a single tree and results," and opens with the startling statement that a stem of a coconut tree on poor land forms a complete register of the periods at which manure had been applied, the effects it produced, and the time during which it operated and became exhausted. How the appearance of the stem of a coconut tree could indicate what crops it bore when manured, for the *effect* of manure is always ganged by the resulting crops, and the period of time the crops were affected by the manure, passes my poor comprehension. [The effect on the stem is obviously meant. Ed. "Ex."] It is well known that on poor soils, neglected coconut trees gradually taper towards the top. A little attention, not necessarily manuring, causes the stem to bulge out again, so that a practised eye could easily detect if a property had been neglected for any length of time and taken in hand again. But for any one to say he can give the effects of such renewed attention, or name the period of time the improvement consequent on such attention lasted, is rubbish.

Now for the account of the tree that yielded astonishing results by the application of manure. The tree existed for twenty-five years on such poor and sandy soil, as no other form of vegetation would grow on. The stem was one foot in diameter at the base and tapered to four inches at the five feet to which it had attained. The leaves measured about thirty inches. No worse specimen of a living plant could be selected, but it was operated upon for the sake of experiment. Twenty pounds of poonac and five pounds of steamed bones were mixed and dug in round the tree in a circle twelve

feet in diameter. The growth was vigorous, and within a twelve month the new leaves had attained a length of fifteen feet. At eighteen months the first flower shewed itself, and the tree again received five pounds of poonac and two of bones. At thirty months it began to give a crop so heavy that fears were entertained of the stem snapping at the thin portion. The same dose of manure was given for the three succeeding years. At the end of the fifth year the wretched specimen had developed into a handsome tree, with the stem at the top over one foot in diameter, and carrying a crop of 60 to 70 nuts, while the previous crops aggregated over 100 nuts. According to the writer, this handsome tree was built up and yielded 170 nuts, with an expenditure of only 75 cents for the 10 lb. of poonac and 13 lb. of bones applied over a period of five years. A very handsome return indeed, and a fit reward for five years of patient attention to a tree described as "the most wretched specimen of a still living plant." How many owning trees answering to this description will feel cheered by this experiment, and be inspired with hope! After this no one will deny the essayist the right to raise himself on a pedestal of his own making, to assert his own superiority over his brother-planters, and with a feeling of pity for their ignorance to address them thus: "There are truths that science has made common property, but which few coconut planters have yet asserted their right in, or indeed become aware of, their existence. How few of them know that 187 lb. of poonac contains *(sic)* all the elements that is *(sic)* removed from the soil in a candy of copperah? How few of them know that the poorest soil may contain some of the elements of fertility that the plant cannot assimilate from the absence or deficiency of other necessary elements? A few measures of quicklime may bring into activity a great fund of latent fertility; a few ounces of bone dust may be the one thing wanting to put a good crop on a barren tree." A sigh of pity is next heard for the poor ignorant goiya, who, we are told, would pronounce the principles of Agricultural Chemistry, if propounded to him, a myth, and the propounder a humbug. No general knowledge of Agricultural Chemistry is possible till the Agricultural School turns its graduates "loose on Society." Next comes a fling at Europeans, of whom "not half a score know anything of coconuts." Then an all-around thrust at proprietors, who, though educated and intelligent, will not deign to look on the scientific aspect of the culture.

I am not one of those who hold it as "an incontrovertible rule" that coconut plants not in bearing should not be manured. What I hold and practise is that laggards should be stimulated and fed to keep pace with the other plants in a field. But I am most decidedly of opinion that plants showing satisfactory and fair growth should not be stimulated into early bearing, *if* you wish your plantation to be a permanency. Experience and observation alike teach us that precocity and longevity are not synonymous, but opposite, terms. *-Ibid.*

THE COCONUT PALM. The king of low-country products is, of course, coconut. What coffee was to the hill country coconut is to the sea board districts. Indeed, it may lay claim to the sovereignty of the whole Island; for the aggregate value of all the varied products of the coconut tree exported cannot, we feel sure, be of greater value than those consumed locally in the shape of food, oil, poonac, thatch, coir-goods, fuel, timber and articles of domestic use. [The proportion of local consumption of products of the coconut (as well as of the palmyra) palm must be immensely greater in value than the export. -ED.] If coconuts never gave proprietors the magnificent profits which coffee at one time yielded, they never, on the other hand, involved them in magnificent losses. Not that coconut cultivation has not its enemies, like other products. White-ants and porcupines and wild-pigs are, at times, formidable to young plantations, and so are

beetles and lightning to established ones; but history refers to no scourge which ever devastated coconut plantations in the way that *hemileia vastatrix* has ruined coffee estates. No natural laws are violated in its cultivation, for the tree is allowed to grow at its own sweet will, without being hacked and hewed to promote fruitfulness, and Nature makes return in longevity and regular crops. These may further be regarded as the reward of patience, and the subjection of the desire to hasten to be rich. Thus has it come to pass that coconut estates have long been regarded in the light of a safe, if slow, investment, as distinguished from a speculation: but, we fancy, during last year, proprietors of estates in full-bearing derived an income from them larger than any other island product has yielded. The oil shipped up to the 30th ultimo aggregated 424,000 cwt. against 300,000 the previous year, and only 184,000 in the year 1881-82. Not only are the shipments far in excess of those of any previous year, but the prices which have ruled about £30 a ton on an average although only about 2-3rds of the figures reached in the fifties have given satisfactory profits to the grower. It does seem strange that an oil locally produced in abundance at small cost, should be superseded by an imported article brought thousands of miles in secure packages; but it is yet the fact that kerosine has largely displaced coconut oil, not only in households in towns, but even in many of the villages among natives. Nothing is more common than to see villagers returning to their homes by trains or on foot with attractive little kerosine lamps and a bottle of the cheap oil. For reading, coconut oil is decidedly preferable, as giving softer and cooler light it has also the advantage of standing gusts of wind better than its mineral rival – but it cannot be compared in cheapness with the produce which the bowels of the earth yield in such plenty in America and Russia. It is not, however, for lighting purposes that coconut oil is chiefly exported, but to be used in the manufacture of soaps and lubricants, and to some extent of candles; and for these the demand will continue. *Ceylon Examiner*, Oct. 1883.

DRAINING OR TRENCHING FOR COCONUTS.

TO THE EDITOR OF THE "CEYLON EXAMINER."

Sir,—It does seem strange that so necessary a branch or the proper and husbandmanlike cultivation of the coconut is so universally neglected. But then the coconut is seldom systematically cultivated, it is simply allowed to grow. Weeding a coconut estate generally receives the exalted term of cultivation, and if a man more intelligent or less apathetic than his fellows acknowledge the necessity of giving back something to the soil for all he is taking out of it, and manure his land, he is supposed to go in for "high cultivation." The coconut receives fair and generous treatment only on such poor sandy soils as refuse to give up elements of fertility they do not contain; and absolute necessity is made a virtue of.

Now to my subject. Trenching is taken up by some to prevent "wash," by others not to be behind-hand with their neighbour. We unhesitatingly assert that there is absolutely no *wash*, in the general acception of the word, on a well-grassed land. The soil is so firmly bound by the roots of the grasses, that not a particle can be displaced by wash. The grass filters and arrests all soil held in solution, even in water rushing from the side drains of roads, wherever such bound grassed land. I had an opportunity of witnessing this while travelling once on a road during a heavy rainstorm. A large stream of water washing through and over a road, found an outlet in a thick and muddy condition on a coconut estate skirting the road. Before the water had gone twenty yards, it was flowing as clear as if passed through a filter! Droppings of cattle, even when dissolved by rain, rarely travel beyond a foot of where they were deposited. The only part of a coconut estate, where rain-water carries along with it any loose soil or decaying vegetable matters, is in a hollow or ravine, and this is owing to the accumulation of water from all sides towards this hollow. Careful trenching, by arresting water before it reaches a hollow, can advert even this slight amount of wash.

Those who resort to trenching to arrest wash throw the soil dug out of the trench on the upper side of it. The absurdity of this becomes apparent with the first heavy rainfall, as the trench, not being traced at any gradient or even level, the accumulation of water wherever there is a depression, causes the earth work to give way, and the rush of water in a volume does all the damage tenfold increased, which trenching was thought to prevent. Every successive rainstorm widens the breach and wears away the earthwork. But I will possibly be told that this soil carried away the breach is caught by an ingenious contrivance for a silt trap designed and used by certain planters, consisting of a fence of live sticks put down at every trench and protected by rubbish and the branches of the coconut. To my mind the game of digging trenches so that the soil thrown up above it is caught in a trap below it, is more expensive than ingenious.

If there be no wash on a coconut estate, where is the necessity for trenching? Not to mention the benefit to a soil in its aeration and increased porosity resulting by a system of trenching, it has the additional merit of storing up and slowly dispensing to the coconut the moisture it revels in, and which is so much of a necessity to mature its nuts. It is not necessary for me to assert that it is more beneficial for a soil to have rain water stored at intervals and slowly filtered through it, parting with the fertilizing matter it holds in solution, than for it to wash over a soil. Saturated as such a soil is with water, it will be better able to stand a prolonged drought than if the water had passed over it, without saturating it to any appreciable extent. I would not cut trenches, as I have always seen done, over long unbroken lengths and to a great depth: and for these reasons. Trenches are cut between the lines of coconuts, and these do not invariably run at right angles to the slope of the land. Consequently, all the water accumulates at the bottom of a slope, and finds an exit there, and only those trees are benefited, where there is an accumulation of water, while it becomes a question whether those at the top are not in a worse plight than before, by having all the moisture, that otherwise might have been there, drained from the roots. And I will not have trenches deeper than a foot or eighteen inches, as the water caught in trenches three or four feet deep is likely to sink beyond the reach of the roots, for, remember, except in very free soil, Coconut roots are seldom found below eighteen inches, deep trenches are likely to drain off too quickly the moisture in the soil. It is best I think to cut trenches in sections of say twenty-five feet, making the bottom as level as possible by cutting deeper where the land is high and less where low and throwing the soil on the lower side. The advantage of cutting trenches in sections is that each section holds whatever water falls above it, benefits the trees adjoining it both above and below, and does not allow the water to flow down to the bottom of the slope and be lost. It is also necessary to fill the trenches with all the droppings from the trees and with weeds, both to prevent too rapid evaporation of moisture, and as manure for the trees, opening new trenches between the old ones as the latter fill up.—Yours truly, AGRICULTURIST.

COCONUT PRODUCTS.

The paragraph we extracted in our last issue from the *Observer*, regarding the fattening of horses on coconut meal in France, was inadvertently published without our remarks. Our contemporary, in referring to the success of the experiment of feeding up horses with the meal inquired, Can the demand for copperah in France be due to this fact? Probably it is, but we fancy the chief reason why copperah is in demand on the Continent is for the oil for Soap Manufactories. Perhaps few have noted the extent to which the exportation of poonac itself has grown in recent years. Mill poonac used to be almost a drug in the market, as cart drivers and others preferred chekka poonac for their cattle, owing to its containing more oleaginous, that is nutritive, matter. Mill poonac, from which a large percentage of oil had been extracted by more effective grinding and greater pressure, was chiefly used locally as a manure, and the demand for export was almost *nil*. We believe Mr. Alexander Stevenson maintained for a long time the fertility of his Dimbula properties by manuring them with unlimited quantities of poonac

from the Kelani Ganga Mills. His firm now exports the better part of the refuse which he used to send upcountry; and during recent visit to the Hulftsdorp Mills, which we were enabled to pay through the courtesy of Mr. G. B. Leechman, we saw large quantities being packed in gunnies for export. The price at which the poonac sells has more than doubled—R15 per ton being now the price, as against R30 in former years. According to the Customs Return for 1883, over 40,000 cwt. were exported that year, France taking the largest quantity, viz., 18,160 cwt. We have litte doubt that most of this poonac is used in the preparation of cattle food, and in the feeding up of horses, although we have heard that the voyage transforms some of it to linseed meal as well! The market for poonac has been steady for some time past, and there seems no reason to expect a fall.

The demand for copperah too has grown, and very satisfactory prices have been realized, good qualities securing an advance of as much as R5 per candy over the prices which the mills can pay. Of copperah, as of poonac, France takes a very large share, our best customer being British India. The residuum of poonac which all this copperah when expressed must leave, is, no doubt, put to the same uses in Europe as the poonac which is imported direct; but we suspect it is the large quantities of copperah we have exported, which has helped to slacken the demand for oil, and to lower prices; for we have now to take account, in addition to the largely increased exportation of oil, of the heavy exports of the material of which oil is expressed. Whatever the effect on the local manufacturer of oil, the proprietors of coconut estates have largely benefited by the competition for copperah enhanced by expert orders, and by the increased demand for nuts too for export.—"Ceylon Examiner."

COCONUT FIBRE.—SIR—I see a paragraph in your journal about coconut fibre, and should be obliged if you could inform me what is the market price per cwt for this fibre in England, and also what would be the cost of a machine for cleaning it? F. de A., Dact. Philippine Islands, July 11.—[a ton and a half Ceylon coconut fibre, for mattress making, has just sold at 13*l* for brushmaking, a ton fetched 31*l*. The price depends entirely upon the character of the fibre and the uses to which it may be put. For machinery, apply to General Fibre Company (Limited) 141, Fenchurch Street, London; or to Messrs. T. Barraclough & Co., Manchester.—ED.]*British Trade Journal.*

RAVAGES OF RATS AND BATS IN COCONUT TREES.

(From Annual Report of the Jamaica Public Gardens and Plantations for the year ended 30th September, 1884, by D. Morris, M.A., F.L.S. *Director.)*

Numerous letters have been addressed to me on this subject; and, in addition to this, I estimated that at the Palisadoes Plantation under my charge during the late drought, the losses caused by rats amongst coconut trees amounted to nearly £100 per annum.

Dr. Ferguson of Port Maria reports the destruction caused by rats on his extensive coconut walks as "immense;" and the subject has necessarily occupied his attention for some time; while numerous other correspondents speak in similar terms.

The question of protecting coconut trees from the attacks of rats is, therefore a matter of considerable importance, and with the view of contributing something towards this end, I have lately been in communication with coconut planters in different parts of the island, and from the replies received I select one or two, which, as the result of practical experience, will no doubt commend themselves to careful consideration. The first of these replies is from Mr. Joseph Shearer, Vale Royal, Duncans P.O., and is as follows:—

"I got out in 1882, 1,000 sheets galvanized iron 36 inches by 12 inches; they stood me with cost and charges £35. 11s.; and 1,000 tin sheets of the same size, the cost of which was £28 7s. 10d. Although dearer at

first, the zinc sheets are preferable, as near the sea the tin sheets soon become rusted. The rats were so bad in the coconut walks where I used these sheets that I reckoned they paid their cost fully the first year. In putting them on I nailed them flat to the trees with two or three sheathing nails in each. If the coconut trees are very close together a rat can go from one to other across the limbs, and great care should be observed that there are no ladders near by, such as a dry limb hanging on the ground, or a mangrove twig, &c., because if there be any such the rat will get up the tree independently of using the trunk, and the zinc or tin sheets would be of no use. It is useful if you cannot isolate all the trees, at least to isolate clumps. Care must be taken, too, to dislodge the rats from the top before putting on the tin sheets. The best thing I have found for this is sandwiches of bread and phosphoric paste, deposited among the roots and fronds."

Mr John Clark, Haughton Court, Lucea, writes:—

The zinc sheets to protect coconut trees from rats have been tried here with good results; the rats that live in the trees must first of all be driven out of the trees or poisoned; the sheets must then be nailed round the tree, simply flat against the stem, low enough in the case of short trees, so that the rats cannot spring from the trunk below the sheet on to a limb that may be hanging down near the trunk, which they have been known to do. Rats have been seen attempting to pass over the sheets and falling

"The sheets are zinc 12 inches by 12 inches, and apparently 1-32 inch thick, and cost about 8d. each in London. The sheets last no time and are not to be thought of. The nails for putting them on are ordered as 5dy. galvanized shingling nails.

It is very probable that Mr. Shearer's and Mr. Clark's plans which require only galvanized iron (not tin) sheets 36 inches by 12 inches and fastened perpendicularly on the tree by means of a couple of sheathing nails will commend itself for general adoption. These sheets cost, it will be noticed, delivered on the estate, at the rate of £35 11s. per thousand. This is a large sum to expend at once on coconut trees, but the bands are required only for bearing trees, and I quite agree with Mr. Shearer that where the depredations by rats are really bad, the sheets will pay for themselves during the first year. With regard to the preceding remarks it is to be noticed that the rat which commits such damage in coconut trees is the black species, much smaller than the ordinary brown rat of the cane-fields. It is a splendid climber, and as it builds its nest in trees, it is beyond the reach of the mungoose, which is a very indifferent climber. As I have before remarked,* it is only in the open, where cultivation is carefully kept up, and the rats have no special shelter or trees to climb, that the mungoose is a successful rat-killer."

In St. Thomas-in-the-East Mr. James Harrison informs me that he suffers principally in his coconut walks not from rats of any species, but from frugiverous bats (called by the negroes "rat bats," probably, as suggested by Goose, to distinguish them from butterflies to which they give the name of bats). Mr. Harrison finds the best plan to keep down the ravages of the bats "is to shoot them in the day-time whilst hanging in clusters on the trees."

DISEASE OF COCONUT TREES IN TRAVANCORE."

(From the *Indian Forester*.)

Sir,—I shall feel thankful if any of your readers would, suggesting remedies, kindly explain for the benefit of us Travancorians, the following interesting yet disastrous phenomenon:—

Quite recently, in the central and northern districts of Travancore, we have lost several beautiful coconut trees from decay of the tender, unexpected leaf shoot. At first, the lower end of this shoot grows discoloured,

* See "The Mungoose on Sugar Estates in the West Indies," by D. Morris, M.A., F.L.S., Jamaica, 1882.

and, in a few days, general perfection of this and more or less of the cabbage ensues; the shoot droops and, in some cases, falls to the ground; the tree decays soon after, and we are left lookers-on and losers.

In trying to account for this remarkable disease, we are convinced that it cannot be the work of the Rhinoceros or Longi-corn beetle; for both these depredators bore into the shoot, cabbage or stem of the palm and, by early detection and careful tending, in the majority of cases, death can be stayed. But in the case in hand, the only sign to us of the presence of the disease is the drooping on the tree of the leaf-shoot when obviously all our efforts to remedy the evil are ineffectual because too late. The explanation most generally accepted by the natives is that "falling stars" (meteorites, they say) have been at work. Another reason advanced has it that decay is brought about by an exuberance of sap, and that it can be remedied by bleeding the tree. This would at least appear to be plausible, from the fact that in our very moist climate evaporation is too slow to keep pace with the incessant ascent of water in the stem, and that it is only the moist vigorous trees that are, as a rule, affected; but the remedy is desperate. By a third cause given, the malady is attributed to the attacks of fungi.

With all these explanations however, the fact remains that we are losing many of our valuable trees without making any attempt, so far as I know, to, if possible, prevent it. The hot weather has been unusually severe with this year, and the monsoon rains unprecedentedly scanty; but I am not at all certain whether these facts are of themselves sufficient to explain away the very unsatisfactory state of affairs now obtaining in our coconut gardens.—A. M. SAWYER.

THE PRODUCTIVE RESOURCES OF CEYLON.

A LECTURE DELIVERED IN COLOMBO IN 1861 BY THE LATE MR. MEAD.

The lecturer commenced by defining the object of his address, which was an exposition of the nature and value of such substances found in the island, as could be converted into sources of trading profit. For example, the dye-woods found in the hills had no place in the catalogue of PRODUCTIVE RESOURCES, for this reason, that it would cost more than they were worth to carry them to a market; and in like manner many articles intrinsically valuable must be left in the jungle to perish, because either from the want of means of transport, or the difficulty of finding labor at hand, it was not worth while to meddle with them. The island was in reality one of the richest in the world, so far as regarded the extent and value of its natural productions, but inquiries as to their commercial value were beset with difficulty. It was needful in the first place to have the chemist's knowledge of their nature and properties; next, to have a thorough acquaintance with the localities in which they were to be found, and of the facilities for collecting them; and lastly, the knowledge of the merchant was requisite, as to the value of the articles in the world's markets. Those chief obstacles in the way of forming right conclusions, were enhanced in the case of Ceylon, by the incorrigible idleness of the Sinhalese population. Their knowledge of jungle growths was extraordinary, and if they would only turn it to account, their incomes would be largely increased. Oils and gums which abounded, were always saleable even in small quantities, but they would not take the trouble to gather them. Their condition was that happy state as pictured by certain writers, where each man raised his own food and sat under the shade of his own trees. They are not troubled with the hatreds of religion, the passions of politics, or the disturbing influence of literature. They had faith only in the utility of cock-fighting, and the pleasures of the grog shop. In these localities where they formed the sole population, it was idle to attempt the development of forest resources.

The impulse and the power to open up new fields of industry must come from the European, and it was a painful but curious study, to note the character and consequences of the numerous efforts which had already

been made in that direction. When one thought of the docility of Eastern races, their ingenuity and cheapness as workmen, the almost total absence of machinery and the paucity of capital amongst them, it seemed impossible to adopt any other conclusion than this, that the wealth, the energy, and the mechanical skill of our countrymen, must of necessity achieve a brilliant success. Yet scores of enterprises, starting with every apparent advantage in their favor, had failed, and that so utterly, that if a balance could be struck between the fortunes lost and fortunes won in the East, it was doubtful which would outweigh the other. In all such cases there was some element needful to prosperity wanting which no one had thought of, and the absence of which was fatal. It was of the utmost importance that the nature of these chronic defeats should be examined and laid bare, so as deter such speculations for the future.

Mr. Mead proceeded to illustrate the position of foreign industrial enterprise in the East. Whenever machinery took the place of manual labor, the work was done quicker and better, but these advantages were often found not sufficient to compensate for the cost entailed in purchasing expensive plant and maintaining skilled workmen in all seasons. The manufacture of coconut fibre and coconut oil were examples in point. The native methods of producing both were the simplest imaginable. Women and children buried the husks of the nut in water or mud, and when the pulp was thoroughly decomposed, they dug them up and beat out the fibre with a few blows given with a stick. Where ordinary attention was paid, the product was scarcely inferior to that of the fibre machines, and would realise nearly the same price at home, whilst the cost of making it bore no comparison to the expense entailed in producing the same quantity by machinery. In the case of oil making there was no comparison between the working power of the *checkoo*, and that of the crushing mill and the hydraulic press, yet it was beyond question that to manufacture a given quantity of oil, a sufficient number of bullocks and checkoos could be purchased at one-fifth of the price that would have to be paid for setting up the European mill. In the matter of working expenses, the native manufacturer could save 20 per cent. and his oil realised the same price in the English market. In the seasons when it was expedient to stop the manufacture, the mill owner was at the same expense, except in the item of fuel as in the busy time, for he must keep his staff of skilled laborers in pay, for once dispersed they could not be obtained again when wanted. The native competitor placed in the same circumstances would lose nothing. He would put a covering over the checkoo to protect it from the weather, turn the bullocks into the field to plough, or yoke them to a cart, and either dismiss the driver or find other occupation for him. This was a somewhat ungracious topic to dwell upon, but the truth must be told, that in certain departments of industrial effort, we could not compete with advantage against the despised natives, working with imperfect tools, and considered to be in every way beneath us.

But underneath the story of those laudable but fruitless efforts, a great lesson was hidden, that large manufactures could only exist when they were in gear with the state of things by which they were surrounded. Our laws, our arts, our literature, nay, even our religion must suffer a change, in being adapted to the wants of strange nations. All that could hope to live must grow, and become racy of the soil. The only exceptions were the railways, and to a limited extent the steam boat, and steam machinery for agricultural purposes. The first was complete in itself, and once made, it asked no aid from native brains or native resources. Wood and water were to be found everywhere, and having these, the engine went on its way and did with certainty its appointed work.

The lecturer then discussed the subject of FIBROUS plants, with which the country abounded. He exhibited specimens of the *Plantains* the *Sansiviera*, the *Aloe* and the *Pine Apple*, and said that no one who handled those beautiful products, and reflected that they grew wild everywhere could wonder that immense sums of money had been spent in endeavouring to perfect machinery for extracting them. The man who could devise a simple method of drawing out fibres would not merely make his own fortune, but confer an inestimable benefit on his country by relieving the perpetual strain on the Cotton market. But there was as yet no signs of such a desirable result,

The last experiment was that of the Messrs. Stirtge, who spent £10,000 on a machine which was no improvement upon all previous efforts in a pecuniary sense. Yet those were gentlemen who, as Quakers, as Corn-dealers, and as members of the "Peace Society," generally had an eye to their own interests. Fixed machinery, requiring steam power to drive it, could scarcely pay under any circumstances, owing to the fact that the average weight of fibre in textile plants, was only four per cent. To make a ton it was necessary to cut down, cart, and pass through the mills no less than 25 tons, so that it would require an immense breadth of land to furnish material, and a large establishment of carts and laborers to work it up. Hand-labor was out of the question in fibre making, for a man could not make at the outside, more than eight ounces a day: what was required was a simple machine, such as the village carpenter and blacksmith could make and keep in repair, cheap portable, and efficacious and he was not without hope that such a result was within reach. Mr. Mead here exhibited the diagram of a French invention for extracting fibres, which consisted of a wheel carrying round six arms, each of which in turn delivered a blow on the plant, which latter was inserted in a slit cut in one of the posts of the framework. It had been found to answer extremely well in the French colonies, and he intended to have a trial of it made here.

The subject of DYE-STUFFS was next adverted to; the *Wiliilla* and the *jak*, both of which gave a yellow dye, were too valuable for building or furniture work to be exported with advantage, but the *Morinda Citrifolia*, the *Gorakaha* of the Sinhalese and *Cassa* of the Tamils, grew as common weed over the whole country, and gave a good yellow colour, in addition to being an excellent tanning material. It was in all respects equal to Sumach, of which 11,000 tons were annually imported into England at a cost of about 11s. per cwt. The orchilla weed had now become well-known. It grew plentifully along the whole extent of sea board, a few localities excepted, and commanded in the case of a recent shipment £60 per ton. The *Sapanwood* of Ceylon had been driven out of the home market by the Siam article, which could be had much cheaper in that country, and commanded a better selling price. The *Chaya* root, *Oldenlandia Umbellata*, which gave a dark red, fetched more money in the local market, than could be obtained for it in England, so that *Orchilla* and the *Morinda* were the only dyes worth notice on the part of the merchant.

TANNING substances held a chief place in the list of productive resources. The bark of the *Kakata* (*Carcya Arborea*) was one of the most powerful astringents, and so was that of the *Terminalia Alata* the (Koombook) of the Sinhalese. The fruit of the *Tiniberi* (Embryopeltis Glutenifera), contained 60 per cent. Tannic acid. He had discovered the true *Acacia Catechu* in the Northern Province, but believed that it was confined to a single locality. The *Cathartocarpus Fistula* (Triconda) the barks of the *Mangrove* (Kadol), *Anacardium Occidentale* (cajn) were also extremely serviceable to the tanner. Many other astringents doubtless existed, but the above list was sufficiently comprehensive.

With regard to OILS, Mr. Mead said there were but two in addition to those already known in commerce which need be referred to. The seed of the *Margosa (anacardium occidentale*, melia azderach) could be had in great quantities in Jaffna for about ten pence a bushel, and medical men had declared that in cases of consumption its curative qualities rival those of cod liver oil. The *Cordole*, a powerful vesicant, procured from the pericarps of the cashew nut, could be had in abundance for the mere cost of extraction, as the husk was universally thrown away. Other oils could be procured in various parts of the island, but they were either to be had only in small quantity, or were absorbed by local demand. Gingelly seed could be had at the commencement of the season at about 5s. per cwt.

The lecturer brought his address to a close, by pointing out the fields which were open to European enterprise in the cultivation of oil seeds, and dry grains by steam machinery; and the curing of tobacco. A ploughing machine at home could turn up seventeen acres a day, and here, where the land was merely scratched, with a stick, it could get through at least twenty-five acres. Gingelly seed, which was sown broad-cast, gave 60 fold of

increase, and it could be cultivated, reaped, and threshed out by the sole aid of steam. In all cases where steam could begin and end the work, its employment could not fail to be beneficial. It would be far better that the people should look to the dry crops generally, for the country was not suitable for paddy cultivation, in proof of which he stated the fact, that whereas the Government in Pegu assessed the land for taxation on a presumed increase of forty for one, paddy fields in Ceylon returned but six bushels of crop for one of seed. As for tobacco, it was grown extensively in the Northern Province and the District of Negombo, and was considered fully equal to the best of foreign growths, so far as the leaf was in question. But the mode of curing it was most imperfect. In order to develop the best qualities of tobacco it was necessary, after the leaves had been carefully dried, to press them down upon each other with heavy weights, until the sweating process was finished, when it would be found that the leaves were all of one colour and greatly improved in flavour. It would cost but a trifle to erect drying sheds and prepare in the above manner the leaf purchased from the cultivator. Not less than a ton of tobacco must be pressed at one operation, and it was therefore hopeless to expect that the [illegible] could effect the needful improvements.

Samples of arrow-root, tapioca, cassava, and semolina, the latter a substitute for sago, were shewn. The yield of arrow root was 21 cwt. to the acre, giving 15 per cent of flour. The grower sold his produce at 6s. per cwt., and allowing £1 for the rent of land, his profit was £3 3s. The prepared meal sold at 9d. per lb and gave a profit of 21s. per cwt. Tapioca yielding 10 per cent., sold for local consumption at 1s. 3d. per lb. The roots were paid for at the rate of 4s. per cwt., and the manufacturer's profit upon a hundredweight of the starch was within a fraction of £1.

Mr. Mead brought his observations to a close by expressing a hope, that Government would secure the assistance of qualified persons to analyse and report upon the countless mineral and vegetable resources of the Island, and he should rejoice to hear at a future period, that the work had been accomplished during the administration of Sir Charles MacCarthy. His Excellency complimented the lecturer at the close of the proceedings, and said he had been much interested in listening to him. In the course of the evening, Mr. Mead took occasion to remark that the whole of the fibres, starches, &c, had been prepared at the Lunatic Asylum under the care of its highly accomplished and energetic superintendent, Mr. Wambeck. We must not omit to mention that the dyed fibres looked very brilliant, and a pair of mats, woven in gold by the lunatics from the aloe and coir fibre, deserve special notice. We had almost forgotten to say, that various medicinal substances were cited by Mr. Mead, as being easily and cheaply procurable, which were now imported at much expense to the Colony.

THE PROCESS AT HULTSDORP MILLS, COLOMBO, OF THE MANUFACTURE OF COCONUT OIL.—(On the occasion of the visit of the Prince of Wales in Dec. 1875.) The factory is surrounded by a grove of coconut trees; at a word, coolies climbed the lofty trunks, and threw down a shower of nuts. These were husked with the speed of lightning and the coconut proper extracted from the husk, which is known in the English market as "cokernut." The nuts were broken, and the milk poured into vats, whence it is removed for cattle food. The Prince traced the broken nuts on to the barbecue, where, exposed to the fierce sunheat, the kernel dries and separates from the shell. The dry kernels were then under the grinding stones and ground into meal—this meal being unctuous and clammy as heavily charged with the oil. The meal was put into presses, and, on the application of screw power, the oil was expressed. The final products were thus the oil, when still remained to be purified by filtering through bags, and the cake, which is used for the feeding of cattle. The Prince then saw the husks or "cokernut" combed by instruments called "devils" into brush fibre and mattress fibre, the latter is often curled and dyed and sold at home as horsehair. Of late years the dry kernel, the "copra" of commerce, is largely imported into England, and the oil extracted there in a manner identical with that witnessed today by the Prince.—ARCHIBALD FORBES in "*Daily News*," Dec. 1875.

REPORT ON THE DESTRUCTION OF COCONUT PALMS BY BEETLES.

(Reprinted by permission of Mr. H. N. Ridley of Botanic Gardens, Singapore.)

The damage caused by the ravages of two species of beetles in Singapore to the coconut trees has now become so serious, that it is imperative that some steps should be taken to ameliorate the plague without delay. For this purpose, I have here collected all the information I could, both by personal observation of the habits of these animals, and by enquiries of the several planters whose estates have been much affected, and by reference also to published notes in the *Tropical Agriculturist*, and in a paper published by authority of the Straits Settlements Government and written by Dr. Simon, together with the correspondence on the subject between the various planters and certain Government officials.

The Species of Beetles.—The two species of beetle which attack palms here are quite different in appearance and habits and in their method of destruction, although they are usually found together, and must be treated of separately. One is *Oryctes rhinoceros*, commonly known as the rhinoceros, elephant or black beetle, belonging to the group of Lamellicornia. The other is *Rhynchophorus ferrugineus*, known as the red beetle: it is a large species of weevil. Two other large species of Calandra occur in the island, both of which prey on some species of palm, but I have not received any notice of their attacking coconuts.

Oryctes rhinoceros.—This beetle belongs to the group of Lamellicornia, the larvæ of which live in decaying vegetable matter. In the case of this species, the parent beetle deposits its eggs in the decaying stems of coconut trees, whether still erect or fallen to the ground. So abundant are they, that I have found as many as forty larvæ, nearly all full grown, in about three feet of a rotten palm-stem. But besides this habitat, it is also stated that the larvæ occur in manure pits, cowdung, tan bark, crushed sugarcanes, and other vegetable remains, and also in mangrove mud; and I have received grubs taken from pits of cowdung and from leaf mould, made by accumulating grass leaves, &c., in a pit which were quite indistinguishable from those taken from rotten palms. Their existence in mangrove mud seems to me incredible, as it appears highly unsuited for them, I have been unable to get grubs taken from mud, and certainly palms growing near mangrove swamps are not more liable to attack than if they were growing in drier soil. The identification of larvæ of this group is very difficult, and can only be undertaken by an entomologist, as all the grubs of the larger Lamellicorn beetles are very similar, and there are a number of harmless, and even useful, species of this group in Singapore. I have attempted to rear the grubs, but without success, as they invariably die in confinement in a few days.

Description of the Grub.—The larva is a fleshy white grub from two and a half to three inches long when full grown. The head is rounded, broad, hard and of a dark chestnut brown colour, and behind it on the next segment is an angular patch of chitine on each side. The body is swollen at the tail, so that the grub can only lie upon its side, as is usual in this class of larvæ. It is covered with short, scattered bristles, most numerous along the sides just below the spiracles. The legs are about half an inch in length, weak, but chitinous, and covered with bristles. The short antennæ are quite hairless, and the jaws are thick and powerful, black with a single tooth below the sharp cutting point.

Description of the Beetle.—The grub passes into chrysalis state in the tree or the rubbish in which it has spent its life, merely making an oval nest in the rotten wood in which to dose. The chrysalis is large and fleshy,

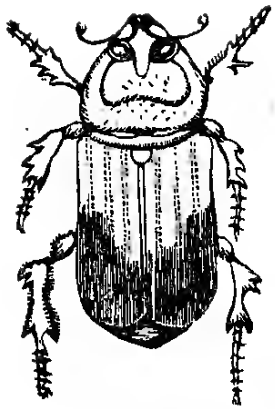
soft and white, and has the form of the perfect insect. It appears to remain but a short time in this state, for chrysalis are very rarely found. Hatched in the tree, it soon makes its way out, and eventually flies off to commence its work of destruction. The beetle varies a good deal in size, but it is easily recognised. Large specimens are nearly 2½ inches in length and very broad, of a dark brown or black colour, the chitinous coat being exceedingly hard. The head in the male is small and provided with a blunt horn curved over towards the back, half an inch long. The thorax is about an inch long and three quarters of an inch broad, very hard and solid: it is smooth, and scooped out in front, so that it slopes towards the head. The back edge of this depression is notched, and there are two small semicircular depressions on either side of the large one. The wing cases do not cover [illegible] completely; they are broad and oblong and raised over the back, smooth and shining, but dotted all over with minute punctures. The under side of the body is red-brown, mostly hairless, but the mouth and all the face in front of the horn is covered with red hairs. The legs are strong and stout, the second joint being armed with sharp teeth, with the aid of which the beetle can tear its way into the tree. The female insect can be distinguished by its very short horn, not a quarter of an inch long, and by the much smaller depression in the thorax, which is not notched at the back, as it is in the male, than which, too, it is usually smaller. The insects fly briskly at dusk, rather high in the air, attacking the palm tree at night.

Destruction of Trees.—The grub of this insect is quite harmless, and indeed rather beneficial than otherwise, as it assists to convert rotting wood and other vegetable refuse into soil. It is the perfect insect that is so destructive. Its method of attack is as follows: It flies by night to a palm, and makes its way to the base of a leaf-stalk, and burrows into the heart of the cabbage, making a large hole, from which projects a quantity of the fibre of the tree resembling tow. The appearance of a tuft of this is evidence that the beetle has been at work. It remains in the hole usually all the next day and may be captured in the burrow. It nibbles in so deeply, that, not rarely, it bites through the growing point in the cabbage, or bud of the palm. More often, the attack is repeated till the rain getting into the burrows sets up decay, which rots the palm through. In either case the tree speedily dies. A tree once attacked seems to be very popular, and I have known palms from which two or three beetles a day could be taken regularly, in spite of all attempts to drive them away by the aid of carbolic acid, salt and other substances.

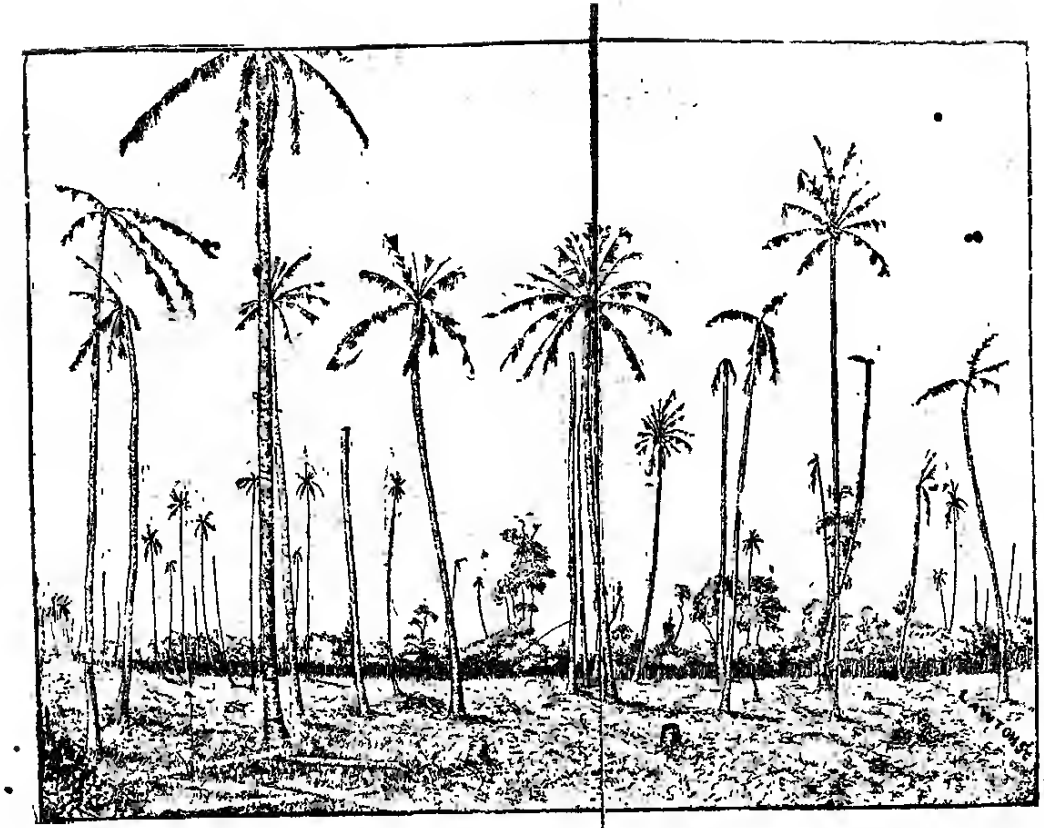
The following species of palm, besides the coconut, have been attacked, and some destroyed, in the Botanic Gardens:- *Cocos plumosa, Martinezia caryotæfolia, Corypha gebanga, Phœnix dactylifera, Livistona chinensis, Verschaffeltia splendia, Areca rubia, Hyophorbe amaricaulis, Elæis guineensis, Sabdalum bracultifera, Borassus flabelliformis,* and several others, but the Betel nut (*Areca catechu*), the Gomuti (*Arenga saccharifera*), the Sago palm (*Sagus Rumphii*), and the slender-stemmed palms seem never to be attacked. I once found a beetle in the act of gnawing through the leaf stalk of a species of Cycad, mistaking it evidently for a palm-tree. It appears that the object of the beetle in thus attacking the trees is to drink the sweet sap in the bud of the palm.

It is very easy to distinguish trees that have been attacked by this beetle by the peculiar ragged appearance of the leaves. The beetle in burrowing into the bud, often bites straight through the folded leaf in the cabbage, so that when it is unfolded the top is found to be bitten symmetrically off, or each leaflet is perforated regularly. By these appearances, it is easy to tell whether a tree has been attacked or not, and so to judge of the state of the plantation.

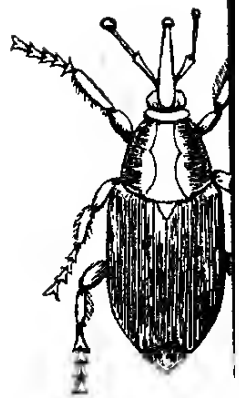
I observe that the trees most liable to attack are those in the neighbourhoods of towns. Small isolated patches round the Malay villages in the



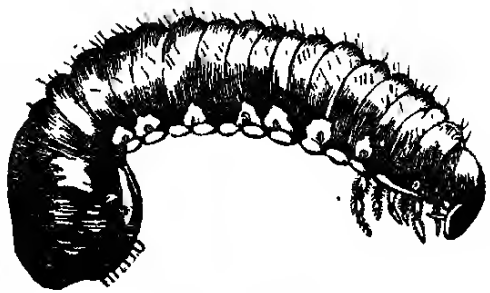
ORYCTES RHINOCEROS.



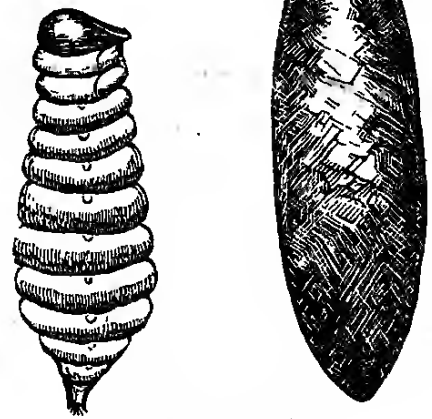
COCONUT ESTATE ATTACKED BY BEETLES.



RHYNCHOPHORUS FERRU



LARVA OF ORYCTES.



LARVA AND PUPA CASE OF RHYNCHOPHORUS.

interior of the island are usually quite free from the attacks, even though the plantations are near mangrove swamps. It has been said that in this position the trees always suffer, and that the grubs are bred in mangrove mud. This is erroneous. I have seen many plantations near mangrove swamps without any trace of damage from beetles, and it is exceedingly improbable that the grubs are able to live in mangrove mud. When a plantation is abandoned or neglected, as soon as one or two trees die, the beetles come to attack and lay their eggs in the decaying stumps. From one tree they fly to another, and soon the whole plantation is in a dying state, and if there be any other estates near at hand, the beetle goes on to them, and will do a great deal of damage.

It would be easy enough in a clean-kept estate to keep down the beetles, but where there is an endless supply of them in an adjoining estate, the matter is of great difficulty, and the destruction is something remarkable. A rotten coconut tree lasts a very long time in a state of decay, and over a thousand beetles could be bred from one before it was quite destroyed. Not only do the grubs live in the erect and fallen stems, but the butts left in the ground are often full of them, and I have even seen them in the timber of little bridges made of two or three pieces of coconut stem laid across a ditch in a plantation.

Other timber they do not attack, as it does not decay into the powdery, soft mass that they require for the grub to live in.

Methods of Destruction.—The usual method of destruction of this insect in the trees, is to employ men to examine the bases of the leaf stalks of the palms frequently, and to search for the beetles. They are provided with a flexible iron or copper wire terminated by a barb, with which the beetle is speared in its burrow and drawn out. A tree once attacked should be frequently examined, as it is more liable to future attacks than those which have never been attacked. So long as the beetle is killed by the spear, there is no real need to extract it; in fact it is, to a certain extent, advantageous to leave its remains in the hole, as no beetles will again enter the hole while the dead one is there. In any case, it is advisable to plug the holes with bits of rag or tufts of fibre dipped in weak carbolic acid, as this will deter beetles. Many planters affirm that putting salt in the crown of the tree will keep away beetles. I have not found this remarkably successful. Probably the salt is indirectly beneficial by being washed down to the roots by the rains, and there absorbed, and as anything that improves the health of a tree enables it also to resist and recover from the attacks of insects, the manuring by salt in this manner is of advantage indirectly against the pest. Kerosine and phenyl may also be used in place of carbolic acid, but they are less effective.

Another method of destruction consists in making large fires of the fallen leaves and husks in the plantations at night. The brilliant light of the fires attracts the beetles, which are beaten into the fires by men and and boys armed with branches of trees.

Plan for Extermination.—Although it is obvious that there will always be sufficient food in the form of decaying vegetable matter to supply the needs of the beetle, so that it is really impossible to exterminate it, its numbers can be very greatly reduced by destroying in and near plantations all rubbish, leaves, husks and other vegetable refuse, or at least not allowing piles of it to accumulate. All dead trees should be cut into small pieces and burnt. And whereas it is absolutely useless for any cultivator to keep his plantations clear of rubbish in which beetles may breed, while his neighbour has so neglected his trees that they become merely nests of beetles, it should be made compulsory on every cultivator of coconuts, to however small an extent, to destroy by fire all dead trees on his grounds; nor should he be permitted even to utilise them as bridges or posts in the plantations.

Rhynchophorus ferrugineus, the Red Beetle.—This is almost more destructive than the proceding kind, and attacks the palms in quite a different method. It is here not the perfect insect, but the grub that does the injuries.

Like the black beetle, the red weevil is nocturnal in its habits, flying at night to deposit its eggs in the coconut trees. Possessed of a remarkably long ovipositor, it finds its way to the base of the leaf-stalk of the palm, and pushes the egg as deeply into the body of the tree as it can. It frequently makes use of the holes made by the elephant beetle, and can often be extracted thence by the beetle-spear. The egg on hatching produces a white footless grub, entirely different in appearance to that of the elephant beetle. It burrows tunnels through the soft growing portion of the palm, and when full-grown nibbles its way to the surface, and forming an egg-shaped cocoon becomes a chrysalis, and eventually hatches out into the perfect insect. Some persons affirm that the beetle lays its eggs in the base of the tree, and that the grubs then burrow upwards. I have seen no case of this, nor have I ever seen the beetle at the foot of the tree, unless the palm happened to be stemless. In all the trees affected by the red beetle, that I have cut up, I found grubs only in the soft pithy wood at the base of the cabbage, and here they were sometimes thickly crowded together. I have certainly seen burrows made by some insect in the old stems of the coco palm, but I do not believe that they were the work of this animal, but, probably of some Longicorn-beetle, several species of which occur here, and the grubs of which eat hard wood.

Like the elephant beetle, this species attacks also other palms besides the coconut. Many of those mentioned as attacked by the former in the Botanic Gardens having also being attacked by the latter.

It is by no means so easy to find out when a palm is attacked by this insect, as it is in the case of the preceding. It works entirely inside the tree, and makes little or no external marks. By listening at the side of the tree the grub can be heard gnawing the wood. But usually the withering and fall of the central shoot is the first sign that anything is wrong. In some cases a tree exudes a shiny liquid having an unpleasant sour smell, which is a sign of serious damage.

Description of the Grub.—The grub is a thick, fleshy, cylindrical, opaque white larva, with no feet or antennæ, quite hairless, except for some scattered hairs on the head and also a few on the tail. The head is small in proportion to the body, oblong and black, with small jaws. The segment next to the head is horny, but softer and paler than the head, with some substriangular darker patches on either side. The body is curved and wrinkled, and almost equally thick without. The tail ends in a flat, squared process, with a few tubercles on which there are hairs. The grub lives in the burrows which it makes, and which are full of slimy sap exuded from the injured wood. It moves about by the aid of its thickened segments, and usually burrows transversely through the tree. When full grown it attains a length of a little over two inches.

The Perfect Insect.—The perfect insect varies a good deal in size and colouring. Usually about two inches in length, but often not more than one and a half from the tip of the snout to the end of the tail. Like all weevils, it possesses a long curved snout, which is blunt at the tip, and in the male ornamented with a kind of brush of reddish hairs. The head is very small, and usually more or less red.

The thorax broadest behind and narrowed in front is black, with a broad red band in the centre, smooth and polished. The wing cases are black, sometimes ornamented with red, grooved longitudinally, and square and blunt at the ends, a good deal shorter than the body. The tail is black, edged with reddish fur beneath. The legs are strong, rather long,

black, with a strong claw on the end of the second joint, besides the two small ones on the feet. The antennæ are a little shorter than the snout, abruptly bent in the middle, and ending in a club.

It is the smallest of the palm-weevils here, and easily known by the colouring. It flies at night, but is rarely seen on the wing.

Method of Destruction and Prevention.—This insect, as has been stated above, is a much more difficult one to deal with, but several of the methods in use for the former species will be equally effective with the latter. The insects, both male and female, may often be found at the base of the leaves, and can be extracted with the beetle-spear before the eggs are laid. They may also be destroyed by fires, as in the case of the black beetle.

Some planters have recommended cutting away the fibrous sheath which surrounds the young stem of the palm, and, as they say, trimming and cleaning the palm. But the result is attended with a certain amount of danger. For there is great risk that the trimmer will accidentally wound the tree with his knife, and the beetle is quick to take advantage of this and to deposit its eggs in the cut. I quote from *All About the Coconut Palm* by Messrs. Ferguson of Colombo, p. 12:

"Scores of instances might be recorded where, till the trees were come into bearing, a red beetle was never seen, but no sooner was the land cleared and the trees trimmed then it made its appearance and became very destructive. On one property, the trimming system had been carried on for years, till indeed more than one-third of the original plants perished before the estate was ten years old, and they were going at the rate of three trees weekly. The work of trimming was stopped for the reason offered above; the loss of trees continued for some time afterwards, but at the end of six months it had entirely ceased."

The cutting of notches by climbers in the trunk of the trees has been said to be injurious, under the impression that the red beetle may deposit its eggs in the notches, but, as previously stated, it does not attack old wood, that being too hard for the grub, and besides were it to deposit its eggs on the trunk of the tree, it would be exposed to the attacks of birds and bats during the operation. It certainly, however, does take advantage of the holes made by the elephant beetle, and it is very common to find both kinds of beetle in the same holes. It is very probable that the extermination of the black beetle will greatly reduce the number of the red one, by preventing their getting into the heart of the tree by means of the burrows of the black beetle.

Many planters are of opinion that a tree once attacked by the red beetle should be immediately destroyed, on the grounds that the tree is doomed and the grubs in the tree can then be killed. But a very considerable proportion of the trees attacked recover. Unless one or more of the grubs bore through the growing point at the base of the cabbage, or sets up decay in the heart of it, the palm has a very good chance of recovery. At the same time, a tree once attacked is usually liable to further attacks from both kinds of beetles, and unless it is really a valuable tree, it is perhaps hardly worth attempting to save it. It is hardly necessary to state that when the central bud is destroyed, the palm cannot recover, and is practically dead. In this case, it should be destroyed at once, and the top cut out in order to find the grubs before they escape as beetles. Cutting the grubs out has been tried by several planters, and spearing them through the stem would be equally effective, but the results seem hardly to be worth the trouble. The grub when detected is usually at least half grown, and then deep within the tree, so that the tree has to be very deeply cut into to get at it, and probably this would set up internal decay.

Summary.—It is quite clear that, although it would be impossible to absolutely exterminate every beetle in the place, it will be possible to so

far reduce their numbers that the damage done by them is infinitesimal. The large planters may be trusted to keep their plantations clean of any rubbish in which the black beetle may be propagated, and to destroy all dead and decaying palms on the estate, but that will avail little if other persons are permitted to leave dead trees, and piles of tan bark, manure heaps, rotten sugar-cane, &c., in the vicinity of the coconut estates, where the elephant beetle may be bred in large numbers. The small cultivator, to whom the loss of a few coconut trees is of little importance, should not be permitted to let them get into such a state that they are a source of danger to those of others.

It should be made compulsory upon every person owning coconut trees to cut down and burn all palm-trees that are dead upon the ground at once, nor should he be permitted to stack or store the stems in such manner that they can rot upon the ground, nor to use them for bridges or posts.

It should also be prohibited to owners of tan-works, sugar-factories, or other persons in whose trade large masses of vegetable *debris* form a by-product, to permit this refuse to accumulate in such a manner that it threatens the safety of any estate of coconuts. As the beetles do not, as a rule, fly to any very great distance, there are spots in which such accumulations would be absolutely harmless, being too far distant from any coconuts to send beetles to them, and as in some professions the destruction of such waste might be found very expensive, and perhaps injurious to trade, it might perhaps be preferable to merely indict any persons owning such refuse as having a nuisance on his property, should it be shown that any of his neighbour's coconut trees were suffering from the ravages of elephants beetles; and should grubs be found in the deposit he should then be compelled to destroy it.

If these steps are taken, I believe that the injury to the trees caused by the beetle will be mitigated to a very large extent, and the pest almost eradicated.

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THE COCONUT PALM.

(From the Dictionary of the Economic Products of India.)

COCOS, *Linn.; Gen. Pl. III. 945.*

COCUS NUCIFERA, *Linn.; Brandis, For. Fl.; 556*; PALMÆ.

THE COCONUT PALM: THE COIR OR COCONUT FIBRE; PROCUPINE WOOD; COCOSER, *Fr.*; COCOSNUSS, KAIR, *Germ.*

VERN.—*Nárel, náriyal, náriel, nàriyel, nàriyel-ka-pèr*, HIND.; *nàrikel, nariyal, dáb, nàraked*, BENG.; *Nariel, nariyela, náriera, nàliyer, nárgal, jhádá, nárgal*, GUJ.; *Maar, naril, mahad, narel, narat-cha-jhádá, már, naaral*, BOMB.; *Narela, nárula, náralmád, mád, máda, mahad, nárala, narel, naráli-cha-jhada, naral, nar, tenginmar* (the juice-yielding form in Kanara.) MAR.; *Nárel-ká-jhár, nárel*, DUK., *Tenna, tengr, tennan chedi, tenna-maram, tèngay, tayuga*, TAM.; *Nari kaulam, ten-káia, kabbari, goburri-koya, ten kaya, kobri, chullú, kabbari chettu, ten-káya-chettu, erra-bondala, gujju-narrkadam*, TEL.; *Thenpinnu, kinghenna, tengina, tenginá-gida, tenginá-kayi, tengina chippu, tenginay amme, tengunararu*, KAN.; *Tenga, ténn-naram, tenna, nar, kalapa, njor, kalambir*, MALA.; *Nur*, MYSORE.; *Nari-kela, nári-kera, nári keli, langatin*, SANS.; *Jadhirdah, shajratun-nárjil, shajratul-jouze-hindi, nárjil, jouze-hindi*, ARAB; *Darakhte-nárgil, darakhte bándinj, nargil badinj, (narjible*, in Ainslie), PERS.: *Pol, pol-gass, pol-gahá, pol-nawasi, tambili*, SING.; *Ong, ung, ung-bin, ón, onsi, onti ondi*, BURM.; *Kalapa*, JAVA.

DRY KERNEL, COPRA (KOPRA) OR COPPERAH.—*Khópra*, HIND.: *Khópra*, GUJ.; *Khópré, khópré-ki-batti*, DUK.; *Kobbarait-téngay*, TAM.; *Kobbera, kobbera-tenkaya*, TEL.: *Koppara*, MALA.; *Kobari, kobbari*, KAN.

OIL, COCONUT OIL. *Khópáre-ka-tél, nariyal-ka-tél, naril-katèl*, HIND.; DUK.; *Nárikél-tail, nariyal tél*, BENG.; *Naryal-nu-tel*, GUJ.; *Náraticha-téla, naral-tela, kóbra, cha-téla*, MAR.; *Tenga-ynynney, taynyn-nunay, tengái-yenne*, TAM.; *Tenkáya nune, tenkáia núnay*, TEL.; *Ténna-énna, ninak, kalapa, ninak-nur, narnainak, kalambir, kalapa ninak*, MALA.; *Teugina-yanne, cobri*, KAN.; *Nárikela-tailam*, SANS.; *Dhonun narjal, dhonul-jouze-hindi* (*jouz -hind* in Ainslie), ARAB.; *Róghane-nasyil, róghane-badinj*, PERS.; *Pol-tél*, SING.: *On-si*, BURM.: *Cay-dua*, COCHIN-CHINESE.

WATER. *Yelnir-ka-pani*, DUK.; *Yella nir*, TAM.; *Yellu-niru*, TEL.

TODDY.—*Náréli*, HIND.; *Nárél-ki-sendi, narillie*, DUK.; *Téngi-kallu, tennan-kallu, temang-kallu*, TAM.; *Tenkáya-kallu, tenkala*, TEL.; *Nargilie, nargilli*, ARAB.; *Táriye-nérgil*, PERS.

FIBRE.—*Coir.*? (See first paragraph of chapter on Coir), HIND.; *Tennam nar*, TAM.; *Tenkaia nar*, TEL.

COCONUT CABBAGE.—*Tennam kuchu*, TAM.; *Tenkaia gurtu*, TEL.; *Naril-ka-krute*, ARAB.

COTTON OR TOMENTUM.—*Tenna naruttu pungie*, TAM.; *Tenkaia-chettu-puthie*, TEL.; *Tennam-puppa*, MAL.

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HABITAT.—A pinnate-leaved palm, with a straight or often gracefully curved stem, marked by annular scars; cultivated throughout tropical India, and Burma, especially near the sea coast. On the eastern and western coasts it is particularly abundant, more so towards the south. There are several cultivated varieties but all flower in the hot season, the nuts ripening from September to November. Dr. Shortt states that in South India the Palm thrives at altitudes up to 3,000 feet above the sea, and he even mentions one on the Shevaroy Hills at 4,500 feet. Coconuts are abundant at Bangalore up to 3,000 feet.

Starting from the Bay of Bengal, the coconut palm follows the Gangetic basin inland for about 150 to 200 miles; from the western coast its cultivated distribution inland is much more limited, and in Kolaba, for example, is little more than half a mile from the beach. In very exceptional circumstances, or under the most careful garden cultivation, it may be seen further inland in Bengal than stated, and it even occurs in some parts of Assam. It is, however, essentially a plant of the coast, and luxuriates by the islands of the Indian Ocean. The Indian region of the coconut may thus be said to be the lower basins of the Ganges and the Brahmaputra, and the Malabar and Coromandel coasts. In the Brahmaputra valley it ascends is an introduced tree as it nowhere occurs in forests far away from human dwellings. On the Malabar coast, and on the islands off the coast of India, it may be different; but even in these localities it rarely exists as a forest tree, although it is self-sown. It is abundant on the Laccadive Islands, and on the Nicobar group in the Bay of Bengal, but excepting the recent efforts at cultivation, it was formerly rarely met with on the Andaman Islands, which are only 72 miles to the north. It reappears again, however, abundantly on the Cocos Islands, a small group lying some 30 to 40 miles still further north (where it is in no way cultivated). M. De Candolle states briefly the arguments in favour of an American as well as those of an Asiatic origin for this tree, and concludes by expressing the opinion that it most probably belongs to the "Indian Archipelago." Its introduction into Ceylon, India and China, he states, does not date further back than three thousand years "but the transport by sea to the Coasts of America and Africa took place perhaps in a more remote epoch, although posterior to those epochs when the geographical and physical conditions were different from those of our day."

CULTIVATION OF THE COCONUT.

It is commonly reported that there are in India 480,000 acres under the coconut. A number of passages from Indian authors will be found scattered through the present account of the palm, which every now and again recur to the question of its cultivation. It may, however, be desirable to give here a brief abstract of the opinions published by the better known European writers, since from these may be gathered the results of scientific experiments.

SOWING.—Ripe nuts, carefully collected, should alone be employed as seed, and for this purpose they are usually gathered from February to May. Seed from very young and very old trees should be avoided. After having been kept for a month to six weeks they should be planted. This may take place in January to April, or again in August, provided the rains are not heavy. The seed-beds should be dug 2 feet deep and the nuts planted 1 foot apart. The nuts should be laid on their sides, leaving 2 inches of their surface exposed. Ashes, or ashes and salt, should be freely placed on the trenches; these act both as a manure and as a preventative against insects. The seed-bed thus prepared should be kept moist, but not soaked. The germinated seeds may be transplanted when they are in their second to their sixth or even twelfth month. In the Gadaveri district they are placed in their permanent positions when three to four years old. In damp localities the transplanting may be done in the hot season, otherwise during the rains.

TRANSPLANTING.—The seedlings should now be put out in the plantation, pits 12 yards apart having been prepared for them. In rich soils the pits may be small, but in poor soils 1 to 2 yards wide and 2 or 3 feet deep. In cold clay soils these pits should be filled with sand. In marshy land, walls should be constructed around them. Ashes are often recommended to be freely mixed with the prepared soil to be put into the pits, as this is supposed to prevent the attacks of the beetles that prove so destructive to the trees. Cultivation of turmeric, arrow-root, &c., in the pits, along with the coconuts, is believed to be beneficial. The soil round the seedlings is also often kept damp by a bed of leaves, particularly such as will not encourage, but rather check, the approach of ants into the prepared soil. If the soil be naturally poor, salt, ashes, paddy-straw, fish manure, goats' dung, and dry manures may be added during the first year.

TREATMENT OF PLANTATION.—By the end of the first year the normal leaves will begin to form, and at this stage the soil around the plants should be dressed and ashes added. Every succeeding year the ground should be opened out and manured about the commencement of the rains, the soil being replaced and levelled about the close of the rains. By the fourth year the stem begin to appear and has about 12 leaves; it is distinctly visible by the fifth year, when the tree has about 24 leaves. The spathes commence to be formed by the sixth year, and the stem is then 1 to 2 feet above the ground, but in exceptionally favourable climates and soils it may be three or four times that height. The first few spathes do not form fruits, but bye-and-bye they begin to do so, and in three or four more years the tree is in full bearing. Dr. Shortt says that in good soils and if watered the coconut begins to yield in the fifth year, but in poor soils and if not watered they only commence to yield in the seventh or not till the tenth year. About six months after flowering the fruits set, and by the end of the year they are fully ripe.

Coconut palms may be easily transplanted, and indeed often with advantage. Some of the fibrous roots should be cut away, and manure, together with a little salt, placed in the pit in which it is intended to plant the tree.

YIELD.—As a rule a coconut throws out a spathe and a leaf every month: each flowering spike yields from 10 to 25 nuts. The produce of a tree in full health and properly tended may be from 50 to 120 and even 300 nuts a year, the yield depending greatly, of course, on the suitability of the climate and soil for coconut cultivation; a safe average would be 100 nuts a year to each tree in full bearing. The coconut will continue to bear for 70 to 80 years.

CULTIVATED FORMS.

There are five recognisable varieties of the coconut met with in Ceylon. These have been described as, *1st*, the *Tembili*, a plant with an oval-shaped nut of a bright orange colour; *2nd*, a more spherical form; *3rd*, a heart-shaped fruit of a pale yellow colour, with an edible inner rind, which turns red when the outer skin is removed; *4th*, the ordinary form; *5th*, a small nut about the size of a Turkey's egg. This last form is rare but much admired. Spon (*Encycl.*, 1353) says "there are some 30 varieties of coconut distinguished by the natives of the districts producing them, but many of these distinctions are obviously groundless." Repeated reference will be found throughout this article to the different forms which occur in India, but of these, with perhaps the exception of that met with in the Laccadives, scarcely any deserve special mention. The Laccadive small-fruited form, with a soft, fine, but strong coir, seems well worthy of special

consideration where the object of cultivation is the production of fibre. Dr. Shortt says there are 30 different forms in Travancore. He adds: "The largest variety of coconut that I have seen and examined comes from Ceylon. I have occasionally seen specimens nearly as large from the Coromandel coast. There is a small dwarf variety which fruits while it is about 2 feet high; the plant continues to grow and with age attains to a height of from 10 to 15 feet." A small form is met with in East Africa that does not possess the fibrous pericarp. In Indian newspapers announcements of branched coconuts occasionally appear, as also of branched date-palms. These are viewed with superstitious horror by the ignorant. They are most probably the result of two plants growing together, or of two or more embryos in one nut.

SOIL.- The coconut "thrives best in low, sandy situations, within the influence of the sea breeze, and never attains the same perfection when grown inland." (*Spon's Encycl.*) Simmonds writes: "Soils suitable for a coconut plantation are variously described as below, particularly observing that stony grounds, or those overlying rocky foundations, are to be avoided:-

"1. Soils mixed with sand, either dark-coloured or river-washed.

"2. Where sand is mixed with clay, ferruginous earth, or black mould.

"3. Clayey soils where the under-strata consist of sand.

"4. Sand and clay, even when mixed with gravel and pebbles.

"5. The sea-shore banks of backwaters, rivers, tanks, and paddy-fields.

"6. Alluvium of rivers and backwaters, provided a yard and a half of land is to be generally seen above water-level.

"7. Marshy land even in brackish soils (but not where salt is formed in crystals by evaporation).

"8. All level lands exposed to the sea breeze, where the soil is good, as the valleys between hills, tanks, and ditches which have been filled up.

9. Lastly, even the floors of ruined houses well worked up, and any places much frequented by cattle and human beings on account of the ashes and salts of ammonia from the urine, &c., deposited day by day in the soil."

Simmonds further say: "The nuts for seed should not, on being gathered, be allowed to fall to the earth, but be lowered in a basket or fastened to a rope. If let fall, the polished cover to the fibres will be injured and collect damp about the nut, or the shell inside may be cracked and the water disturbed. These are fatal injuries, or even if the plants still grow, they will, on being transplanted, not make fresh roots, but produce weak trees having their fronds constantly drying up, nuts rarely matured, and often are even without kernel in those which appear perfect. If the nuts are allowed to dry on the tree before gathering, the plants are liable to be lost, not having water inside to cherish the growth of the sprout (before the actual root shoot into the soil)."

"Nurseries should be somewhat exposed to the influence of the sun, though not too much heat; plants thus grown will even, though deficient in stature, be strong, and when transplanted will not fail, nor suffer from heat. The planting of the nuts should take place in January to April, and also in August, provided the rains are not heavy, and then the planter may expect fruitful trees to be produced when grown; but nurseries formed during the heavy monsoon will generally fail, or produce trees which will yield small nuts. Too much moisture of every kind is injurious to

the plants." Speaking of soils Dr. Shortt says: The coconut requires alluvial and loamy soils for its successful growth, but any soil with a free mixture of sand and clay answers fairly well. Sea-sand where procurable is recommended to be thrown into the pits when the earth is being returned around the plants. Half-sand half-earth is considered the best material to fill up the pits with."

PECULIARITIES OF INDIAN CULTIVATION.

The following passages from the Gazetteers will be found instructive and of value to intending cultivators as having a special bearing on India :—

I. *In Bombay (Kolaba District).*—Of the liquor-yielding trees of this district the cocoa-palm is the most important. "The moist climate, sandy soil, brackish water, and abundance of fish manure, make its growth so vigorous that the yield of juice is much in excess of the wants of the district. The trees are grown within walled-in or hedged enclosures, sometimes entirely given to coconut palms, in other cases partly planted with mangoes, jak, betel-nut, and other fruit trees. Every garden has one or two wells, from which the trees are watered by a Persian wheel. In starting a coconut garden, a bed is prepared, and in it, at the beginning of the rainy season, from twenty to forty large, ripe, unhusked nuts are planted 2 feet deep. The bed is kept soaked with water, and after from three to six months the nut begins to sprout. The seedlings are left undisturbed for two years. They are then, at the beginning of the rains, planted in sandy soil in rows about 18 feet apart, and with a distance of about 15 feet between the plants. For about a foot and a half round each plant the ground is hollowed 3 or 4 inches deep, and during the dry months the plants are watered daily or once in two days, and, once or twice in the year, enriched with fish manure or with a mixture of salt *machni*. When nine years old the trees begin to yield nuts twice a year and sometimes thrice, 120 nuts being the yearly average yield from each tree. The trees are then ready to be tapped. Each cocoa-palm, when ready for tapping, is estimated to represent an average outlay of about 18s. (R9).

"The coconut gardens are generally owned by high-caste Hindus, who let the trees to some rich Bhandári who has agreed to supply the owner of the liquor-shops with fermented or distilled juice. The Bhandári pays the owner of the garden R1 (2 shillings) a month for every three trees (*Kolaba Dist., Bomb. Gaz., XI.*, 28). Of the Thana District it is stated—"The seed-nuts are prepared in different ways. The best and oldest tree in the garden is set apart for growing seed-nuts. The nuts take from seven to twelve months to dry on the tree. When dry they are taken down, generally in April or May, or left to drop. When taken down they are either kept in the house for two or three months to let half of the water in the nut dry, or, if the fibrous outer shell is not dry, they are laid on the house-roof or tied to a tree to dry. After the nuts are dry, they are sometimes thrown into a well and left there for three months, when they sprout. If the nuts are left to drop frm the tree, which is the usual practice in Bassein, they are either kept in the house for some time and then left to sprout in a well, or they are buried immediately after they have fallen. When the nuts are ready for planting they are buried either entirely or from one-half to two-thirds in sweet land, generally from 1 to 2 feet apart, and sometimes as close as 9 inches. A little grass, rice-straw, or dry plantain leaves are spread over the nuts to shade them. If white-ants get at the nuts the grass is taken away, and some salt or saltish mud mixed with wood ashes and a second layer of earth is laid over the nuts. Nuts are sometimes planted as late as August (*Shrávan*), but the regular season is from March to May (*Chaitra* and *Vaishakh*), when, unless the ground is damp and their inner moisture is enough for their nourishment, the nuts want watering every second or third day until rain falls. The nuts begin to sprout from four to six months after they are planted, and when the seedlings are a year

or eighteen months, or, what is better, two years old, they are fit for planting. At Bassein the price of seedlings varies from 5*d.* (3 annas 4 pies) for a one or one and a half year old seedling, to 6*d.* (4 annas) for a two-year-old plant. In planting them out the seedlings are set about six yards (12 *hâts)* apart in the 2-feet-deep holes, in which about 1¼ pounds (2 *tipris)* of wood-ashes have been laid to keep off white-ants, and the garden must be very carefully fenced to keep off cattle. The plants are then watered every second day, if not every day, for the first year; every third day, if not every second day, for the second and third year; and every third day, if possible, for the fourth and fifth year. Watering is then generally stopped, though some Bassein gardeners go on watering grown trees every seventh or eighth day. For two years after they are planted out the young trees are shaded by palm leaves or by growing *mathéli* plantains. During the rains, from its fifth to its tenth year, a ditch is dug round the palm and its roots cut, and little sandbanks are raised round the tree to keep the rain-water from running off. In the ditch round the tree, 22 pounds (4 *páylis*) of powdered dry fish manure (*kuta*) is sprinkled and covered with earth, and watered if there is no rain at the time. Besides fish manure the palms get salt-mud *(khára chikhal)* covered with the leaves of the croton-oil plant, *jepál crand* (Croton Tiglium), and after five or six days with a layer of earth; or they get a mixture of cow-dung and wood-ashes covered with earth; or night-soil, which on the whole is the best manure. Palms suffer from an insect named *bhonga* which gnaws the roots of the tree, and from the large black carpenter-bee which bores the spikes of its half-opened leaves. When a palm is suffering from the attacks of the *bhonga*, a dark red juice oozes from the trunk. When this is noticed, a hole 3 inches square is cut in the trunk from 4 to 6 feet above where the juice is coming out, and is filled with salt, which drives away or kills the insect. To get rid of the boring bee, it is either drawn out by the hand, or it is killed by pouring into the spike assafœtida water or salt-water.

"A well-watered and manured tree, in good soil, begins to yield when it is five years old, and in bad soil when it is eight or ten years old. A palm varies in height from 50 to 100 feet, and is in greatest vigour between the ages of twenty and forty. It continues to yield till it is eighty, and lives to be a hundred.

"When the tree begins to yield, a sprout comes out called *poi* or *pogi* at the bottom of which is a strong web-like substance called *pisnudri*. After about a fortnight the tree flowers, though few blossoms come to perfection. Many of the young nuts also fall off, and only a few reach maturity. A young nut is called *bonda*, a nut with a newly-formed kernel is called *shâle*, and a fully-formed nut *nârel*. A good tree yields three or four times a year, the average number of nuts being about seventy-five" (*Gaz., XIII., I.*, 295.)

In the report of the Kathiawár District (*Bomb. Gaz. VIII., p.* 95), there occurs a short but interesting account of the coconut: "At Mahuva, in 1875, 1,500 acres were planted with 170,000 palms. At Kahndera there is a garden with 7,000 palms, and there are about 2,000 at Bâhvnagar. The advantage of the coconut over the mango is the uniformity with which it bears." "A singular fact about the cocoa-palm is that it grows freely in solid limestone, provided a hole about 3½ feet deep by 3 feet in diameter is cut in the rock and filled with mould. All the trees at Gopnâth are planted in solid rock."

In concluding this account of the cultivation of the coconut it may be stated that, according to the various district Gazetteers, there are from 30,000 to 40,000 acres under the palm, with about 100 trees to the acre. Kánara, Ratnágiri, and Káthiawár appear to be the districts where the

largest number of trees occur. Of Ratnâgiri it is stated that if grown for the fruits only, each tree gives a net yearly profit of 2s. 4½*d.* (R1-3).

II. *In Madras.*—The coconut palm flourishes in this Presidency, frequenting the banks of estuaries and backwaters, and abounding on the sandy tracts near the sea, especially along the Malabar and Coromandel coasts. Although met with in the Bombay Presidency, it is only plentiful in the southern division, and barely leaves the immediate coast. On nearing the Madras Presidency from Bombay it becomes more and more plentiful. Of its abundance on the Malabar coast an opinion may be formed from the description of the town of Cannanore, the clumps of the coconuts being said to be seen between the officers' houses, surrounding the cantonments in every direction, and extending in the distance as far as the eye can reach; the cantonment may be said to be embedded in a forest of these trees" (*Royle*). Of South Kânara, it has been estimated that there are 80,000 acres under the coconut. Indeed, the Malabar coast and the Laccadive and Maldive Islands are pre-eminently the seats of the Indian coconut industry. The enquirer after Indian coconuts, coir, or coconut oil, need practically concern himself with no other part of the country unless he add to these the Nicobar Islands. The last mentioned islands furnish a very large number coconuts, but apparently the islanders are ignorant of, or too indifferent to learn, the art of making coir or expressing the oil. So far this remark seems to be almost applicable to the Maldives also, a group of large islands under a Sultan, who is subordinate to the Governor of Ceylon, and not to the Viceroy of India. This fact is of some importance, since the casual examination of the trade returns might convey the idea that the Laccadives export no coir, if the still further error might not even be committed of supposing the Laccadives to contain no coconuts at all. The Laccadives are mainly under the administration of the Collector of Malabar, and the imports from these islands are treated as if they were the produce of the main-land, while the imports from the Maldives are returned as from foreign territory. Last year the Maldives sent 7,897,453 coconuts to India, and the Nicobar Islands 4,510,000. Of the inhabitants of these groups of islands it is not reported that they manufacture coir, and apparently they prepare only a small amount of copra, although they sell their nuts at a price far below that which prevails on the mainland of India.

Writers in Europe, who have described the commercial article Coir, are in the habit of placing the coir from Cochin in the first rank. Some doubt seems to be associated, however, with the commercial term "Cochin Coir." The small Native State probably alluded is described in the *Imperial Gazetteer* "as possessing no important trade by sea or land." It seems impossible to believe that all the coir returned under the name of "Cochin Coir," could therefore come from Cochin. Indeed, the suspicion exists that the better class of Malabar and Laccadive coir, consigned to Europe, may be so designated, if not also some of the exports of coir from Cochin-China and the Straits. In the returns of the coasting trade for British India it is shown that last year the total exports of coir from Cochin by sea amounted to only 689 cwt., valued at R1,134, and manufactured coir 2,777 cwt., valued at R25,339; these were all sent to Bengal or Bombay; how much may have gone by land to Madras cannot be discovered. It is significant that Dr. Shortt in his Monograph on the coconut palm, which has just appeared, makes no mention of Cochin coir.

Repeated reference will have to be made, in subsequent pages, to the Laccadive and Malabar coir and the other coconut products from these regions, so that we shall here content ourselves with this brief notice of Madras, concluding only by giving the description of the cultivation given in *Morris's Descriptive and Historical Account of the Godavery District*:—"Young plants of a year's growth are planted out, and watered for six years, after which they do not require much water. The trees generally

bear fruit about the ninth year after transplantation. The expenses of cultivation are stated to be R668 for a *putti* of land,– namely, R140, being the price of 600 young plants, R18 being the value of the labour required for planting them, and R400 being the wages of labourers employed to water and tend the trees until they come into bearing. When the trees begin to bear fruit, the value of the produce of a tree, exclusive of the fibre, is estimated at about 12 annas a year, making the total value of the produce in a *putti* of land R300" (*p. 70*).

III. *In Mysore* "there are four varieties of the cocoanut: *1st*, red; *2nd*, red mixed with green; *3rd*, light green; and *4th*, dark green. These varieties are permanent, but although the red is reckoned somewhat better than the others, they are commonly sold promiscuously. Their produce is nearly the same.

"The soil does not answer in the Bangalore district unless water can be had on digging into it to the depth of 3 or 4 cubits, and in such situations a light sandy soil is the best. The black clay, called *ere*, is the next best soil. The worst is the red clay, called *kebbe*; but with proper cultivation all the three soils answer tolerably well.

"The manner of forming a new cocoanut garden is as follows: The nuts intended for seed must be allowed to ripen until they fall from the tree, and must then be dried in the open air for a month without having the husk removed. A plot for a nursery is then dug to the depth of 2 feet, and the soil is allowed to dry three days. On the *Ugâdi* feast (in March) remove 1 foot of earth from the nursery and cover the surface of the plot with 8 inches of sand. On this, place the nuts close to each other, with the end containing the eye uppermost. Cover them with 3 inches of sand and 2 of earth. If the supply of water be from a well, the plot must once a day be watered; but if a more copious supply can be had from a reservoir, one watering in the three days is sufficient. In three months the seedlings are fit for being transplanted. By this time the garden must have been enclosed, and hoed to the depth of 2 feet. Holes are then dug for the reception of the seedlings at 20 feet distance from each other in all directions, for when planted nearer they do not thrive. The holes are 2 feet deep and a cubit wide. At the bottom is put sand 7 inches deep, and on this is placed the nut with the young tree adhering to it. Sand is now put in until it rises 2 inches above the nut, and then the hole is filled with earth and a little dung. Every day for three years, except when it rains, the young tree must have water.

"The cocoanut palm begins to produce when seven or eight years old, and lives so long that its period of duration cannot readily be ascertained. Young trees, however, produce more fruits which comes forward at all seasons of the year. A good tree gives annually a hundred nuts. A few are cut green on account of the juice, which is used as a drink, but by far the greater part are allowed to arrive at some degree of maturity, although not to full ripeness, for then the kernel would become useless.

"Cocoanut palms are planted in Chiknayakanhalli in rows round the arecanut gardens, and also separately in spots that would not answer for the cultivation of this article. The situation for these gardens must be rather low, but it is not necessary that it should be under a reservoir; any place will answer in which water can be had by digging to the depth of two men's stature. The soil which is here reckoned most favourable for the cocoanut is a red clay mixed with sand. It must be free of lime and saline substances. Other soils, however, are employed, but black mould is reckoned very bad. The cocoanuts intended for seed are cut in

the second month after the winter solstice. A square pit is then dug, which is sufficiently large to hold them, and is about a cubit in depth. In this, fifteen days after being cut, are placed the seed-nuts, with the eyes uppermost and contiguous to each other, and then earth is thrown in so as just to cover them, upon which is spread at little dung. In this bed, every second day for six months, the seed must be watered with a pot, and then the young palms are fit for being transplanted. Whenever, during the two months following the vernal equinox, an occasional shower gives an opportunity by softening the soil, the garden must be ploughed five times. All the next month it is allowed to rest. In the month following the summer solstice, the ground must again be ploughed twice; and next month, at the distance of 48 cubits in every direction, there must be dug pits a cubit wide and as much deep. In the bottom of each a little dung is put; and the young plants, having been previously well watered to loosen the soil, are taken up and one is placed in each pit. The shell still adheres to the young palm, and the pit must be filled with earth so far as to cover the nut. Over this is put a little dung. For three months the young plants must be watered every other day; afterwards every fourth day, until they are four years old, except when there is rain. Afterwards they require no water.

"Every year the garden is cultivated for *ragi*, *uddu*, *hesaru*, or whatever other grain the soil is fitted for, and is well dunged, and at the same time four ox-loads of red mud are laid on the garden for every tree that it contains, while a little fresh earth is gathered up towards the roots of the palms. The crop of grain is but poor, and injures the palms; it is always taken, however, as, in order to keep down the weeds, the ground must at any rate be ploughed, as the manure must be given, and as no rent is paid for the grain. On this kind of ground the cocoanut palm begins to bear in twelve or thirteen years, and continues in perfection about sixty years. It dies altogether after bearing for about a hundred years. They are always allowed to die, and when they begin to decay a young one is planted near the old one to supply its place.

"In this country, wine is never extracted from this palm, for that operation destroys the fruit, and these when ripe are considered as the valuable part of the produce. A few green nuts are cut in the hot season, on account of the refreshing juice which they then contain, and to make coir rope; but this also is thought to injure the crop. The coir made from the ripe nuts is very bad, and their husks are commonly burned for fuel.

"The crop begins in the second month after the summer solstice, and continues for months. A bunch is known to be ripe when a nut falls down, and it is then cut. Each palm produces from three to six bunches, which ripen successively. A middling palm produces from 60 to 70 nuts. As the nuts are gathered they are collected in small huts, raised from the ground on posts. When a merchant offers, the rind is removed at his expense, by a man who fixes an iron rod in the ground, and forces its upper end, which is sharp, through the fibres, by which means the whole husk is speedily removed. He then, by a single blow with a crooked knife, breaks the shell without hurting the kernel, which is then fit for sale and is called *koppari*. A man can daily clean 1,300 nuts. From 20 to 30 per cent. of them are found rotten" (*Mysore Gaz., I., 131-134*).

IV. *On the Nicobar Islands* the coconut palm is very abundant, although, as already stated, it exists only under recent cultivation on the Andaman Islands, but reappears still further to the north on the group of the Cocos Islands. Sir W. W. Hunter gives an interesting account of the Nicobar trade in coconuts which may be here quoted: "At present the principal product of these islands is the coconut palm, and its ripe nuts form the chief export." "The northern islands are said to yield

annually 10 million coconuts, of which about half are exported. The estimated number exported in 1881-82 was 4,570,000. As this important product is six times cheaper here than on the coast of Bengal or in the Straits of Malacca, the number of English and Malay vessels that come to the Nicobars is every year increasing." "The trade in coconuts is carried on chiefly by native craft from Burma, the Straits Settlements, Ceylon, &c. Forty vessels of an aggregate tonnage of 6,270 tons visited the islands for coconuts in 1881-82." The Administration Report for 1885-86 gives the exports as 4,510,000 nuts and 5,730 bags of copra. In that year 49 vessels, with an aggregate tonnage of 8,218 tons, obtained permission to trade with the Nicobar Islands for coconuts, &c. The same report states that there are now 112,000 coconut palms under cultivation at Port Blair.

V. *Of Burma* it is reported that the coconut is "largely cultivated and might be much more so in many places along the Arakan coast as it is in Ceylon, and as doubtless it would be but for the sparseness of population, the difficulties of approaching the coast except at a few spots, and the absence of the means of land communication between the ports and the sites fitted for the production of the trees." In the Bassein district of Pegu it has been stated that there are 10,000 acres under coconuts.

In Bengal, while the palm is plentiful throughout the lower Gangetic basin, it exists only in garden cultivation, and the produce is not much in excess of the local demand. There are no large plantations such as have been described in Madras, Mysore, and Bombay, because in Bengal the date-palm is used as the source of palm juice or toddy and not the coconut. It is however, fairly abundant in Noakhally, Backerganj, Jessore, and the 24-Parganas.

VII. *In Upper India* the coconut is alluded to in many works, but only as an article of import and export; it is not cultivated. Dr. Hartwig (*Tropical World*) says: "This noble palm requires an atmosphere damp with the spray and moisture of the sea to acquire its full stateliness and growth; and, while along the bleak shores of the Northern Ocean the trees are generally bent landward by the rough sea-breezes, and send forth no branches to face its violence; the cocoa, on the contrary, loves to bend over the rolling surface, and to drop its fruits into the tidal wave. Wasted by the winds and currents over the sea, the nuts float along without losing their germinating power, like other seeds which migrate through the air; and thus, during the lapse of centuries, the cocoa-palm has spread its wide dominion from the coast to coast, through the whole extent of the tropical zones."

VIII. *Ceylon.* Speaking of Ceylon cultivation Mr. Treloar says: "The ripe fruits are first planted in a nursery, where they are covered an inch deep with sand and sea-weed or soft mud from the beach, and watered daily till they germinate. In two or three months a white shoot containing the foliaceous rudiments springs from one of the three holes in the end of the nut; the radicals emerging from the other two orifices opposite to the shoot, and penetrate the ground." This is not quite a correct description of the germination. The leaf-stalk of the cotyledon elongates and pushes the embryo bodily out of the seed. The blade of the cotyledon remains within the nut forming a sort of arm of attachment. The lower point of the projected embryo elongates and forms the roots, and from a slit in the cotyledonary sheath the plumule or stem makes its appearance. The "three holes" on the nut are all close together, not "opposite" as in the above description and are only spots not holes. But Mr. Treloar proceeds: "The nuts set in April, grow large enough in about four months to be planted out before the annual rains, but for the next two or three years or more the young plants require constant care. They must be watered and shaded from the glare of the sun by screens of plaited leaves from the coconut tree or the fan-shaped fronds of the palmyra."

ENEMIES TO THE COCONUT.

It is commonly stated that if the soil be too rich a large grub with a reddish-brown head soon finds its way to the roots and into the stem. This eats its way through the tissues until the leaves turn yellow, the terminal bud withers, and the tree is killed. This appears to be the beetle known as *Butocera rubus*. "In the Straits of Malacca, the chief natural enemy of the tree is a species of elephant beetle, which begins by nibbling the leaves into the shape of a fan; it then perforates the central pithy fibre, so that the leaf snaps off; and lastly, it descends into the folds of the upper shoot, where it bores itself a nest, and, if not speedily extracted or killed, soon destroys the tree. A similar kind of beetle is known on the Coromandel coast, and is extracted by means of a long iron needle or probe, having a barb like that of a fish-hook. By using this and by ponring salt or brine on the top of the tree, so as to descend amongst the folds of the upper shoots, the evil may be prevented or got rid of." This destructive beetle is known to entomologists as *Calandra palmarum*; but still another beetle bores round holes into the stem itself and lives there. Rats, flying-foxes, and squirrels injure the tree and sometimes kill it by eating the tender terminal bud or cabbage. It is equally necessary to protect the trees from wild hogs, elephants, cows, porcupines, all of which graze on the young plants. But of the dangers to which the coconut is subject none are so great as the attacks of beetles, two of which are alluded to above. Mr. Trelear says of Ceylon: "Still more formidable is the *Coorominyo* beetle (*Butocera rubus.*) which waits to pierce the tender trunk near the ground, and to deposit its eggs in the cavity whence the young grubs, directly they are hatched, begin to eat their way up through the centre of the tree to the young leaf-ends at the top." The West Indian plantations are said to have been devastated by the attacks of a small beetle (*Passalus tridentat*, and a similar calamity is reported to have occurred in Zanzibar through a species of *Oryctes*.

The Burmans are great adepts at detecting the beetles in date and coconut palms and extract them as prized articles of food.

GUM.

The stem of this well-known tree is in Tahiti said to yield gum. It forms large stalactitic masses, red-brown, translucent or transparent. (*Spon's Encycl*). Cooke, in his report on Gum and Gum-resins, says that this gum was sent to the Madras Exhibition of 1855 from Travancore." No other author appears to allude to this gum however, and it therefore seems probable that if produced it is met with only in certain localities. The writer cannot recollect ever having seen a gum adhering to the stems of the palm.

DYE.

In a patent obtained by Mr. J. H. Baker (No 5,139. March 29th, 1825) the whole or every part of this tree is claimed as a dye-ware, especially the husk enclosing the fruit, and the foot stalks of the leaves. The dye was to be extracted by water, cold or boiling, or by solutions of lime, potash, ammonia, &c., and was to serve for dyeing nankeens, blueblacks, &c. The infusion was likewise to serve as a substitute for nutgalls in Turkey-red dyeing. The material does not appear ever to have come into practical use." (*Crookes.*)

Mr. Liotard says of this dye property:—"Produce a dirty-brown (*kahaki*) colour and is a good deal used from its abundance. Lime and *chunda* are added as mordants." Drury remarks that "the shell when burnt yields a black paint which in fine powder and mixed with *chunam* is used for colouring walls of houses." Coconut oil is frequently employed in certain processes of dyeing. Thus in Mysore powdered myrobalams and sulphate of iron mixed with coconut oil are used for imparting a black colour to silk. It is not known whether any other oil might serve the purpose of the coconut,—in other words, whether or not that oil possesses special properties that assist the tinctorial actions.

The natives of India generally do not seem to be aware of the dye properties. The milk is, however, said to be used by plasterers both in India and Ceylon, from an idea that when mixed with lime or colour-washes it increases the adhesive property and gives a polish. For this purpose vegetable matter of some kind is, as a rule, added to cements.

COIR FIBRE.

Thick pericarp or outer wall of the fruit yields the valuable coir fibre of commerce. The sheaths of the leaves are used to wrap up articles, and as paper to write upon. At the Colonial and Indian Exhibition the writer proposed that they should be tried as a means of strengthening harness, the softer layers being even used for corsets and as surgical splints. The fibre of the leaf-stalks is also prepared, and might prove useful in the manufacture of paper. A delicate tomentum or cotton is often seen at the base of the leaf; this is used as a syptic. But the most important fibre yielded by the coconut palm is of course coir. The name of this fibre is said to come from the Malayalam *káyar* (from the verb *kayáru*, to twist) through the Portuguese corruption *coiro*. "The word appears in early Arabic writers in the forms *kánbar* and *kanbár*, arising probably from some misreading of the diacritical points (from *káiyar* and *káiyar*)" (*Yule & Burnell*). *Kayer* is said to be also the Tamil for a rope.

Both the fibre and the rope were first exported to Europe about the middle of the sixteenth century, but it was not until the great International Exhibition of 1851 that coir rope and coir matting attained a commercial importance in England. The merit of this modern trade is largely due to the efforts of the following firms, *viz.*, Messrs. Chubb, Round & Co., and Messrs. Treloar & Sons of London; the Oriental Fibre Mat and Matting Co. Highworth, Wilts: Messrs. W. I. Sly and T. Wilson of Lancaster, who were the patentees of improved machinery for making figured fabrics of coir.

Although a considerable amount both of coir fibre and yarn is exported from India, the article, taking India as a whole, is obtained chiefly as a by-product. It is accordingly inferior in quality and colour to the special coir obtained from Cochin, the Laccadives, Madras, Malabar, Ceylon, Singapore, &c. Locality seems to exercise a considerable influence over the quality of the fibre,—soil, climate, and proximity to the sea being important influences. But there are other considerations. Certain varieties or cultivated forms of the coconut are better suited than others for the production of coir. If cultivated specially for the supply of juice or to afford fruit, the fibre would appear to be in the one case imperfectly formed and in the other overgrown. A great deal depends upon the collection of the fruit at the exact time the fibre is mature, and this followed by an accurate system of steeping, beating, and cleaning the fibre, completes the manipulation calculated to produce the superior qualities of coir. (*Conf. with Mr. Jackson's report in next paper.*) "The fibre appears in the market in various degrees of fineness, depending on the age at which the coconut was cut and husked, and the care bestowed in steeping and cleaning." Mr Treloar says: The usual indications are that the commoner and coarser fibre comes from the old nuts, and the finer, lighter quality from the new; but there are, of course, essential differences in the qualities brought from each locality, and the Cochin are usually best." "Here let it be parenthetically but emphatically remarked that *any attempt to give to coconut fibre a fairer hue by the process of bleaching is to destroy its quality if it be good, and if it be of common quality to make it almost worthless.*"

Properties of the Fibre and Season when Mature.—"The Cochin has the purest hue and fetches the best price." On this account it has been customary to imitate this by bleaching. "Coconut fibre is tough, elastic, springy, easily manipulated within certain limits, and eminently suitable for manufactures where lightness, cleanliness, and great indestructibility are required. It will stand water, is almost impervious to wind and wave, or to damp and rain, and, as we have seen, flourishes in the saline breath of the sea: but it will not stand bleaching. It gives up when confronted with sulphuric acid, chloride of tin, or any other chemicals which are designed to convert it into a sham product. *For this reason we use none but unbleached fibre in any of our manufactures*; and although two or three varied shades of colour are frequently to be seen in one of our

ornamental mats, and sometimes form a simple pleasing pattern, they are obtained by combining or incorporating in the same mat different descriptions of *natural* unbleached fibre." *Spons' Encyclopædia* has it that the fibre "is much impaired by waiting for the nuts to arrive at maturity, consequently, for fibrous purposes, the latter are usually cut at about the tenth month. If cut earlier than this, the fibre is weak; if later, it becomes coarse and hard, requires a longer soaking, and is more difficult to manufacture." Dr. Buchanan Hamilton in his journey across Mysore states (*I., 156*) the green coconuts are sold for their husks, from which fibre is extracted, but the husks of the ripe coconuts are commonly burnt for fuel (*II., 50*). At the same time immense quantities of apparently ripe coconuts, in husk, are sent to Europe, the coir from the husk being there separated, cleaned, and manufactured. Mr. Jackson of Kew in the *Planters' Gazette*, describing a visit to Messrs. Chubb, Round & Co.'s factory, gives an interesting account of the process of husking there pursued. He says: "the enormous heap of husks—which, indeed, is known in the locality as the 'mountain'—comes upon view immediately upon entering the premises, and one can scarcely, at first sight, realise the fact that the enormous pile is composed entirely on these apparently useless portions of the fruit. At the time of my visit this reserve stock of husks was estimated at considerably over a million and a half." Coconuts or as they are generally termed in the trade, "Cockernuts," to distinguish them the Theobroma Cocoa, which furnishes cocoa and chocolate, are shipped principally from Trinidad, Jamaica, Demerara, Tobago, several of the other Leeward Islands in the British West Indies, Ceylon, Belize (British Honduras), all round the coast of America, and the Fiji Islands. Nearly all the nuts are imported in the husk or outer covering, from which, on arrival, they are stripped by men using two fine-pointed steel chisels, and who, by constant practice, become so skilful in the art that many are able to open 1,000 to 1,200 nuts per day. The nuts themselves after being removed from the husks are generally sold to wholesale fruit dealers, who, in turn, supply the retailers, costermongers and others, &c." In the above passage Mr. Jackson has furnished the Indian people with new ideas. India is not enumerated by him as one of the countries that furnish coconuts to England; the fibre of what appear to be mature coconuts is actually used; the consumption of coconut kernel has in England attained a vast proportion, and the fibre can be cleaned after apparently having been kept for years on the nut. These facts open up a new field of trade of which with a little assistance the Nicobar and Laccadive Islands might profitably and without fear of any rival hope to enjoy a large share.

Separation of Coir in India.—"The removal of the fibre from the shell is effected by forcing the nut upon a pointed implement stuck into the ground: in this way a man can clean 1,000 nuts a day. The fibrous husks are next submitted to a soaking, which is variously conducted. In some places they are placed in pits of salt or brackish water, for 6 to 18 months; in other places, fresh water is used, but it becomes foul and injures the colour of the fibre. The chief point to be considered is the duration of the soaking; if it be continued too long, the fibre will be weakened; if it be curtailed, the subsequent extraction and cleansing of the fibre will be rendered more difficult. The most approved plan of conducting the soaking is in tanks of stone, brick, iron or wood; steam is admitted to warm the water. By this means the operation is rendered very much shorter, and the fibre is softened and improved. The further separation of the fibre from the husk is largely effected by hand. After thorough soaking, the husks are beaten with heavy wooden mallets "and then rubbed between the hands." *Spons Encyclop:* Royle and Marshall give the same facts

Robinson describes the separation and clearing of the fibre as practised in the Laccadive Islands as follows:—"When soaked sufficiently long, it is taken out of the pit and beaten with a heavy mallet. Subsequently it is said to be rubbed with the hands until all the interstitial cellular substance is separated from the fibrous portion. When quite clean it is arranged into a loose roving preparatory to being twisted, which is done between the palms of the hands in a very ingenious way, so as to produce a yarn of two strands at once."

"As the husk gets hard and woody if the fruit is allowed to become quite ripe, the proper time for cutting it is about the tenth month. If cut before this, the coir is weak; if later, it becomes coarse and hard,

and more difficult to twist, and requires to be longer in the soaking pit, and thus becomes darker in colour. When cut, the husk is severed from the nut and thrown into soaking pits. These, in some of the islands, are merely holes in the sand, just within the influence of the salt water. Here they lie buried for a year, and are kept down by heaps of stones thrown over them to protect them from the ripple. In others, the soaking pits are fresh-water tanks behind the crest of coral. In these, the water, not being changed, becomes foul and dark coloured, which effects the colour of the coir. When thoroughly soaked the fibrous parts are easily separated from the woody by beating. If taken out of the pits too early, it is difficult to free the coir from impurities; if left in too long, the fibre is weakened, as is said to be the case also with that soaked in fresh water." (*Robinson's Report on the Laccadives.*) In the Maldives (neighbouring islands under the suzerainty of the Governor of Ceylon) coconuts are very plentiful, and enormous quantities of both the nut and the fibre are exported to India and Ceylon. (*See the further paragraph on trade in nuts.*)

From what has been said in an early paragraph regarding the cultivation of the coconut palm in Mysore, it will be seen that the opinion prevails that if tapped for the juice the fruit bearing is materially injured. If this be a fact ascertained and borne out in other parts of the country, it might be inferred that regions like the Malabar coast, where tapping is largely practised, would not be suited for the production of good fibre. On the other hand, Royle says: "But the fruit bearing power of the trees may be considerably improved by extracting toddy from the blossom-shoots for the manufacture of jaggery during the first two years of its production, after which it may be discontinued. In the Konkan the opinion is held that "if tapped the trees become unproductive much sooner."

The Bombay process of extracting the fibre is briefly described in the *Bombay Gazetteer* of the Thana district: "The fibrous part of the outer coating is made into coir by the Bassein gardeners. For this purpose the fibres are stripped from the nuts, left under water for two months, and then beaten by a wooden mallet." The writer cannot discover any detailed description of the process adopted in India generally (except that of the Laccadives) for the separation, steeping, and cleaning of the fibre, but to the best of his knowledge it agrees with what has already been given; although in the Laccadives, the Malabar Coast, Ceylon, and other important coir-producing countries, the art is carried to greater perfection the fibre being correspondingly superior to that prepared on the mainland of India. Large portions of the coast of India (see above in a passage from the *Burma Gazetteer*) are so inaccessible that the methods pursued in Ceylon and elsewhere are scarcely applicable, and, indeed, where applicable, are not pursued, from the greater importance attached to the palm as a supplier of toddy or juice. Dr. Stocks urges that the coconut might with advantage be cultivated on the brackish soils in the neighbourhood of Karachi, and it seems possible that a coir industry might there be developed. It has been reported that in Madras coconut cultivation has been successfully prosecuted in the reclamation of salt-impregnated lands where nothing else would thrive. (*Gen. Admin. Report, p. 95.*) A curious fact in regard to coconuts grown on salt marshes is conveyed by the following passage:—

"The coconuts growing in mangrove soils on the side of creeks, and more or less saturated with salt, have their milk brackish, and the sap is saline also. These trees do not suffer from the attacks of the rhinoceros beetle, and are found to bear much sooner than those planted in a sandy soil" (*p. 182-83*).

INTERESTING FACTS CONNECTED WITH THE TRADE IN INDIAN COIR.

Although, as suggested, the better class fibre is most likely not produced where tapping for the juice is practised, still it should not be forgotten that the Malabar ports are the chief seats of the export of coir, from India. In most works (written in Europe) on the subject of coir, the statement is made that the best quality comes from "Cochin." As already stated, it is not quite clear, however, whether the Native State of Cochin or the whole of the Malabar coast is meant, or whether Cochin coir is a mere commercial term for all good coir wherever obtained. In the Indian

regions alluded to above, coconut cultivation is prosecuted to a considerable extent. Of Cochin (Madras) it may be said, coir is perhaps the most important article of export from that Native State, but Dr. Shortt (*in his Monograph on the Coconut Palm*) does not apparently mention Cochin coir. He states that the best Madras coir comes from the Laccadives, Amindivi, Kadamat, Kiltan, and Chetlat. As indicated by the passage quoted above from Mr. Jackson's paper Messrs. Chubb, Round & Co. do not, it would seem, use any Cochin fibre but prefer a husk which they separate from a mature or at least edible nut.

In a recent report on the trade of Madras, the progress of the coir industry of that presidency for the past twenty-five years is shown. The average export to Foreign and Indian ports for the five years ending 1860-61 were 148·220 cwt., valued at R3,74,801; and for the five years ending 1880-1881, they were 271,934 cwt., valued at R21,79,767, while for the year 1881-82 they were R23,54,202. Of the last mentioned valuation, the exports from the Malabar coast alone amounted to R22,43,000. From these figures a definite idea may be obtained of the immense importance of Malabar and the Laccadives as the chief seats of the Indian coir industry, since the Madras Presidency heads the list of Indian exports. This idea is borne out by the statement made by Royle that "the Laccadive Islands are famed for the good quality of the coir which is made there and exported to the Malabar coast." Again, speaking of the peculiar form of the palm grown in the Island of Kiltan, Royle observes: "It requires no attention and comes into bearing early. The tree is not so large and strong as that of the coast, and the nut about two-thirds of the size only, and round in shape. The husk is smaller and less woody, and the fibre finer and more delicate but stronger than that of the coast nut. The nut is also said to be more compact and oily, and to keep better than the coast nut, although, for the sake of coir, the nut is cut before being quite ripe." How far the exports of coir from the Malabar coast correspond to Indian-grown coir cannot be discovered. The Northern Laccadives are administered by the collector of Malabar and the Southern by Alí Rájá of Cannanore. Sir W. W. Hunter (in the *Imperial Gazetteer VIII., 304*) says: "The article (coir) is paid for to the producers at fixed prices, and is sold on the coast at the market rates; the difference constitutes the revenue or profits of trade of the Government and Alí Rájá respectively. The latter pays a fixed tribute of R10,000 (£1 000) to the Government on account of the islands which he manages. No change has been made for many years in the price which is given by Government for the coir produced in the islands attached to Kánara." The returns of the coasting trade of India do not specify the amounts of coir sent from the Laccadives to Malabar, so that the somewhat interesting subject of how far the juice-extracting industry of the coast is combined with the preparation of fibre cannot be definitely learned. The following facts are, however, instructive:—

Imports of coir (manufactured and unmanufactured) into Madras from other Indian ports—

		Cwt.	R.
1884-85	... ...	14,745	95,881
1886-87	... ...	13,750	81,386
Exports to other Indian ports—			
1884-85	... ...	186,869	12,66,356
1886-87	... ...	128,228	7,98,255

Turning to the tables that give the details of these figures it is shown that of raw or unmanufactured coir Madras receives none from British or foreign Indian ports, so that unless the Laccadives, which (as stated above, are treated as part of Malabar), furnish a very large amount, a considerable local production must exist on the Malabar coast to allow of the extensive exports given above, and the still larger exports shown in the returns of foreign trade. In the *Imperial Gazetteer* it is stated of the Malabar district alone that "the value of exported coconut products is estimated at nearly a million sterling annually."

In a previous page some indication of the extent of the Nicobar trade in coconuts has been given. There does not, however, appear to be any trade in coir, although it seems possible that one of the inducements that

bring the native and other crafts from Ceylon and the Straits, for the cheap Nicobar coconuts, may be to use these in supplementing their home supplies—supplies which are in much demand in the coir market. It may be worth while suggesting that an effort might with advantage be made to instruct the natives of the Nicobars in the art of preparing the coir fibre—an art so profitably practised by their neighbours, the islanders of the Laccadives. This is, indeed, one of the most hopeful aspects of a possible enhanced Indian trade in coir, until such time as the cultivation of the palm can be more vigorously prosecuted along the Coromandel coast to Burma. It seems remarkable that the cheap coconuts sold in the Nicobar Islands should attract traders from Ceylon and the Straits, while India appears to make little or no effort to participate in the advantages of that trade. This is perhaps due to the administrative arrangement which has associated the Maldive Islands with Ceylon instead of India, the Ceylon traders calling at the Nicobar as well as the Maldive Islands.

YIELD PER NUT OF FIBRE AND PRICE.

Mr. Robinson, in his *Report on the Laccadives*, states that the difference in the quantity of coir manufactured from a coast nut and from an island nut in very considerable. We may premise that 40 coconuts are said to yield 6 lb. of coir in Ceylon. Mr. Robinson remarks: "Three large coast nuts will yield 1 lb. of coir, measuring 22 fathoms; whereas, ten small, fine island nuts go to about 1 lb. of coir, but this will measure 35 fathoms: 2 lb. of such yarn, measuring from 70 to 75 fathoms, are made up into *sooties* of which there are 11 to a bundle, averaging about a maund of 28 lb. A Mangalore candy of 560 lb. will thus be the produce of 5,600 nuts, and should contain about 20,000 fathoms of yarn. The actual price of coir received by the Islanders is about R13 per candy. The value of the coir produce of a tree is calculated to be from 2 to 2½ annas: and that of the produce of 100 trees from R13 to 15." "The average value of the total raw produce of a tree bearing fruit would then be seven annas to half-a-rupee; and that of a plot of 100 trees, R45.' For the nuts which they export to the Malabar coast they got from R7 to 10 per thousand, or rather, 1,100, as 10 per cent. is always allowed for the luck in these sales. The Islanders export from 300,000 to 400,000 nuts annually. The natives bring their coir to the coast in March and April which is then received into the Government godowns. Until the year 1820 all coir was paid for at the rate of R21-4-0 per Mangalore candy, or R25 per Calicut candy of 640 lb. After that year the coir was divided into three classes. Since then the average price paid for a Mangalore candy of Ameendevy and Kadamat coir has been R20-2-0 (or R23 per Calicut candy of 640 lb.) But for the Kiltan and Chetlat coirs, which are the best, an average of R20-12-7 or R23-12-0 per Calicut candy is paid. Up to A.D. 1825-26, the Bombay and Bengal Governments took almost the whole of the coir brought from these islands, and credited the Mangalore Collectorate with R25 per candy. The price has since fallen very much during the last twenty years. It has been frequently below the price paid to the islanders, and at best has never yielded above 12 to 20 per per cent profit. The average imports of coir have been from 500 to 600 candies. Mr. Morris, in his account of the Godavery district, Madras, give the following brief statement regarding the production and yield of coir:—

"The Coconut tree yields an excellent fibre. The quantity of fibre in the above extent of land (a *patti*) is estimated at 150 maunds, yielding R93-12-0, at 10 annas a maund. The fibre is prepared by the outer covering of the coconut being moistened and beaten with wooden mallets, after the fibre has thus been loosened. The coir thus obtained is twisted into ropes. The fruit is exported, but very little of the fibre." (*Morris's God. Dist. 70.*)

Spon's Encyclopædia gives the London prices of coir as "Cochin—good to fine, £19 to £25 a ton; coarse, £16-10s. to £19-15s. Yarn—good to fine, £26-10s. to £46 a ton; medium, £21-5s. to £28-10s.; common, £14 to £22-10s.; roping £18 to £24."

USES OF COIR.

"The fibrous husk of the coconut is not its least valuable product; and gives rise to a very large trade, both in the East and in Europe. At first it was only used in this country (England) for stuffing mattresses and

cushions, but its applications have been enlarged and its value greatly increased by mechanical processes, and in a small pamphlet issued by Mr. Treloar, more than twenty years ago, he stated that its natural capabilities having been brought out, coir has been found suited for the production of a variety of articles of great utility and elegance of workmanship—table-mats, fancy baskets, and bonnets, &c. Instead of being formed into rough cordage only, and mats made by hand, by means of ingeniously-constructed machinery the fibre is rendered sufficiently fine for the loom, and matting of different textures and coloured figures is produced, while a combination of wool in pleasing designs give the richness and effect of hearthrugs and carpeting. Brushes and brooms for household and stable purposes, matting for sheep-folds, pheasantries, and poultry yards, church cushions and hassocks, hammocks, clothes lines, cordage of all sizes and string for nurserymen and others, for tying up trees and other garden purposes; nosebags for horses, mats and bags for seed-crushers, oil-pressers and candle-manufacturers, are only a few of the varied purposes to which the fibrous coating of the coconut is now applied.' (*Simmonds, Trop. Agri.*, 244.) The uses of coir are of course so varied and extensive that it is scarcely necessary to enter upon them in greater detail than indicated in the above passage. To the natives of India it is invaluable as lasting in a damp climate. It is accordingly universally employed in tying the bamboos used in the construction of their huts.

Fibrous Sheaths of the Leaves and Coconut Cotton.—A brief reference has been made to these in an early part of this article. The finer ones are used as filters and sieves, but the coarser are apparently put to no purpose, although they have been proposed as suitable for paper-making. They might be used to strengthen saddlery, and even for ladies' corsets and splints. Knox says of Ceylon that "the filaments at the bottom of the stem of the coconut may be manufactured into a course cloth called *gunny*, which is used for bags and similar purposes."

On the young sheaths and petioles a brown-coloured cotton or tomentum will be seen similar to that already described under *Borassus flabelliformis* (B. 680). This is sometimes collected and used by the natives to stop bleeding from wounds. A good sample of it was shown at the Colonial and Indian Exhibition.

Cadjans.—The leaves are plaited into mats and screens and also made into baskets, and combs are said to be made of the midrib of the leaflets in the Friendly Islands. In the Laccadive Islands mats are made of the coconut leaf. These mats are of fine quality and much esteemed when exported. In the Islands they are employed for the sails of the smaller boats. "The Sinhalese split the fronds in halves, and plait the leaflets neatly, so as to make excellent baskets, and under the name of *cadjans* they form the usual covering for their huts, as well as of the bungalows of the Europeans." "The died fronds are sometimes used as torches or for fuel; their midribs, tied together, are sometimes used as brooms for the decks of ships, as the fibres of the stalks are woody, brittle, and difficult to clean."—(*Royle*).

COLLECTIVE TRADE IN COCONUT PRODUCTS.

This trade, as with every other article of Indian produce or manufacture, is referable to three great sections: (*a*) internal trade or local consumption; (*b*) inter-provincial trade adjusting the balance of local demand; and (*c*) foreign trade (*e.g.*, imports and exports) to and from India and other countries. Where the coconut grows it is of such importance and enters so largely into the daily life of the people, that little or nothing can be ascertained of the actual consumption. The returns of road, river, and rail traffic throw some light on this, and the coasting trade affords another means of arriving at an approximate estimate of a certain proportion; but even these returns fall far short of establishing a tangible conception of the total local consumption. Wherever the palm grows, each villager, as a rule, has some trees, the produce of which is used up by himself or sold to his less fortunate neighbours, without having to go many yards from the spot where produced. At the same time, a considerable amount of the inter-provincial exchange must

necessarily figure again under foreign exports, or at most re-exports, so that while the returns of foreign trade include but a very small proportion of the production, it would be unsafe to reckon these up with the available returns of coasting and inter-provincial trade. To give some idea of the present position and growth of the trade in the coconut palm it will not be necessary to go further back than the year 1850. Royle, in his *Fibrous Plants of India*, gives the Imports and Exports for that year compiled from the records of the Statistical Department of the India Office. Accepting these as correct (remarking only that a certain amount of the coasting trade is included by that author with the foreign trade) we may summarise his results in the following statement :—

All published Imports and Exports for 1850.

	Imports.	Exports.
	R.	R.
Nuts	5,21,889	10,110
Kernels	8,66,120	1,31,008
Coir and Rope	2,31,934	2,81,514
Oil	76,618	1,51,843
Shells	5,970	*Nil*
Cadjans	2,990	*Nil*
TOTAL	17,08,551	8,77,505

This gives a grand total of R25,86,056; that is to say, less than the foreign imports of last year. To compare with the above statement of TOTAL TRADE, the following table of the FOREIGN TRADE for 1886-87 (exclusive of all internal and inter-provincial or coasting traffic) may be given :—

Foreign Imports and Exports for 1886-87.

	Imports.	Exports.
	R.	R.
Nuts	5,98,203	8,462
Copra (or kernels)	11,76,799	79,836
Coir (unmanufactured)	6,839	77,391
,, (manufactured but exclusive of ropes)	1,50,701	19,14,448
Oil	7,54,515	13,24,589
TOTAL	26,87,057	34,04,726

If to the above table of foreign trade we were to add the returns (included by Royle) of coasting trade from Malabar, the Laccadives, Coromandel, Konkan, &c, the comparison would be brought out still more forcibly, but, as the tables stand, the foreign imports and exports to and from India of coconut products were last year valued at over 60 lakhs of rupees, whereas in 1850 (removing approximately the items of coasting trade) they were considerably less than one third that amount. The most striking feature of this development has been the growth of the trade in manufactured coir and in oil. As far as the returns of foreign trade indicate, it would appear that the imports and exports of coconuts and of *copra* or *khopra* (a commercial name for the kernels) have remained stationary during the past forty years. How far the returns of foreign trade can be accepted as an indication of total trade may be learned from the following statement of the values of the coasting trade in coconut products during the year 1886-87 :—

Coasting trade in	Imports.	Exports.
	R.	R.
Nuts	24,21,941	16,88,773
Kernels (copra)	35,31,115	23,00,958
Coir	12,20,749	9,27,302
Oil	20,60,067	20,74,455
TOTAL	92,33,872	69,91,188

The table furnished by Royle for the trade in 1850 practically corresponds to the two last-given tables conjointly, so that instead of 25 lakhs the present sea-borne trade has expanded until it may now be returned as valued at 223 lakhs of rupees. It has been remarked that a certain amount of the inter-provincial coasting traffic may reappear as exports to foreign countries or figure in the road, river, and rail traffic to interior parts of the country. While, therefore, the estimate of 223 lakhs must include duplex if not multiplex returns (*e. g.* Bengal imports from Malabar figuring again as exports to foreign countries or re-exports to other Indian provinces), Bengal at the same time produces coconuts and the rail and river traffic from Bengal to Assam, the North West Provinces, the Central Provinces, Central India, and even the Punjab, may be viewed as very considerably in excess of the overlappings of sea-borne traffic. Take by way of illustration one item of this internal trade: Bengal sent to Assam in 1883-84 coconuts to the number of close upon two millions, valued at R69,000. In a like manner Bombay imports coconut products from Madras, Ceylon, Zanzibar, &c., and distributes doubtless a large proportion of these inland, competing with Bengal for the Central tracts of India where the palm does not grow, but at the same time Bombay produces a large quantity of coconuts locally, and these are added to the foreign imports in the competition of the Indian internal trade. The importance of the internal trade may further be demonstrated by the fact that while Madras exports far more to foreign countries than all the other provinces put together (and indeed it takes the largest slice in the coasting export trade), it receives by sea practically no coconut products. Its entire supplies of Malabar and Laccadive fibre and copra seem to be conveyed to the port of shipment by internal means of transport. India is itself perhaps the largest consuming country in the world for coconut products, so that, recollecting this fact, a conception of the total trade may be had by adding to the sea-borne traffic an allowance for local production. Even when this has been done, a very imperfect idea will have been obtained of the value of the tree to the people of India. The mere returns of trade cannot give a just conception of the importance of a product which, like the coconut to a large population, may be said to be their source of wealth as well as their food, drink, and occupation.

TRADE IN COIR, MANUFACTURED AND UNMANUFACTURED.

In all the returns of this subject care is taken to explain that these do not include ropes—coir ropes and cords being placed under a general heading with all vegetable cords.

I. The exports of RAW COIR are, however, so insignificant that a false impression is likely to be conveyed. The so-called manufactured coir, which figures extensively in the returns, appears to be largely crude coir yarn which is dressed and employed by the European manufactures, but of course a considerable trade is also done in mats, rugs, carpets, and other such manufactures. Glancing at the figures of the foreign trade in Coir (unmanufactured), the trade would seem to have practically remained stationary for many years past, and to be too small to justify the conclusion that India participates anything like to the extent it might in meeting the home market. The exports have averaged from 10,000 to 15,000 cwt. for the past twenty years: they were last year 12,317 cwt., valued at R77,391; but in 1883-84 they reached to 24,098 cwt., valued at R1,59,583. The foreign imports of coir are from Natal and Ceylon, and the bulk of these go to Bengal. The coasting trade last year conveyed from one Indian port to another the following quantities of unmanufactured coir: Imports 18,052 cwt. and exports 17,713 cwt. Of this trade, Madras exported 15,586 cwt. and imported only 309 cwt., Bombay exported 2,146 cwt. and imported 8,836 cwt., while Bengal exported only 1 cwt. but imported 8,335 cwt. The bulk of the Bombay and Bengal supplies came from Madras (*viz.*, 5,756 cwt. and 7,615 cwt. respectively). Of the exports to foreign countries the United Kingdom received 10,215 cwt. of last year's production, and of that amount 8,910 cwt. were consigned from Madras.

II. OF MANUFACTURED COIR (excluding ropes) India imported last year (48,709 cwt.) valued at R1,50,701 and exported 208,622 cwt., worth R19,14,148. Of the imports, Ceylon sent 17,657 cwt., of which Bengal received 11,956, valued at R1,22,552. Of the exports, Madras sent to foreign countries 168,

878 cwt., valued at R15,69,771. Bombay and Bengal each sending about 20,000 cwt. Of these exports the United Kingdom received 186,395 cwt, valued at R17,32,815. and next in importance for coir France, 9,836 cwt., the United States, 2,621 cwt., Australia, 2,485 cwt., and Arabia 2,545 cwt. &c.

Of the coasting trade in manufactured coir the imports and exports from one province to another were—imports 150,306 cwt., valued at R11,16,957, and the exports 131,665 cwt., valued at R8,36,427. Of these, Bengal received 60,500 cwt., Bombay 74,561 cwt., Sind 1,776 cwt., Madras 13,441 cwt. The Bengal and Bombay imports came mainly from Madras and Travancore, Cochin ranking next. The importance of Travancore as a seat of the coir-manufacturing industry may be demonstrated by its imports into Bengal and Bombay; Madras sent 30,485 cwt., valued at R2,61,199, and Travancore 27,613 cwt., valued at R2,86,277; to Bombay, Madras sent 50,264 cwt., valued at R2,72,567, and Travancore 17,327 cwt., valued at R1,10,269. At the same time Madras last year sent a large amount to Travancore, *viz.*, 14,283 cwt., valued at R1,36,810. Of the total exports in the coasting trade (*viz.*, 134,665 cwt.) Madras sent to other ports 112,612 cwt., and Bombay, next in importance, exported only 21,617 cwt. Of the total coasting trade in imports (*viz.*, 150,306 cwt.) Bombay generally heads the list; it received last year 74,561 cwt., while Bengal took 60,500 cwt., being followed by Madras with 13,441 cwt. Sind and Burma are unimportant: the former received only 1,776 cwt. *Thus it will be seen that both in foreign and internal trade the coir industry is mainly concentrated in the Madras Presidency.*

COIR ROPES.

Nothing can be learned as to the extent of the foreign and internal trade in coir ropes and cords, since the trade returns for these are published jointly with those of all other ropes. It has been said however, that coir string is universally employed by the natives of India in the construction of their bamboo huts. For this purpose alone the consumption must be enormous. The merits of coir as a rope fibre are now fully appreciated throughout the world, the elasticity and lightness of the fibre making it eminently suited for this purpose. But to these properties has to be added its great power of withstanding moisture even under continued actual submersion. On these grounds it is in great demand for maritime purposes as hawsers, although its roughness renders it unserviceable for standing riggings, its elasticity being for such purposes a disadvantage. It is, however, better suited for running riggings, its lightness being taken advantage of. In the *British Manufacturing Industries* (on fibres and cordage) it is stated, "Coir is one the best materials for cables on account of its lightness, elasticity, and strength. It is durable and little affected when wetted with salt water. Numerous instances have been related of ships furnished with this light, buoyant, and elastic material riding out a storm in security, while the stronger-made, though less elastic ropes of other vessels have snapped in two. Of coir and coir-made rope, about 9 or 10 million pounds are annually shipped from India. Much of it is prepared in Ceylon, but Cochin is noted as the port of shipment for the best quality of yarn, and many thousand cwt. are annually exported from there." This statement of many thousand cwt. being shipped from Cochin should be compared with the trade returns quoted and the remarks made in an early paragraph. In *Spons' Encyclopædia* the following opinion is given of coir fibre for the purpose of cordage: "In Dr. Wight's experiments, coir cordage broke at 221 lb. Though not superlatively strong, the elasticity of the fibre and the capacity it exhibits of withstanding the action of sea-water, render it valuable for cordage purposes, to which it is widely applied locally, besides being less extensively imported into this country for a similiar use." Messrs. Harton & Co., of Calcutta, placed in the Colonial and Indian Exhibition a trophy of ropes of which a striking feature was the arches of hawsers, 12 inches in diameter, thrown across the path; some of these were made of coir.

OIL.

The sliced kernel, dried at ordinary temperatures, either in the sun or artificially, contains from 30 to 50 per cent. of oil. The method of extracting this oil in India, especially when it is required to be colourless, is as follows: The kernel is boiled with water for a time, then grated

and squeezed in a press. The emulsion thus obtained is next boiled until the oil is found to rise to the surface. The ordinary commercial oil is expressed by rude oil-mills worked by oxen.

The oil is white and nearly as fluid and limpid as water in tropical climates. It has a sweet and, according to some tastes, an agreeable odour when fresh, but is liable to become rancid in a short time.

In Europe the oil is chiefly used in the manufacture of candles and soap. In India it is employed in cooking, and as medicine when fresh, and for burning, painting, soap-making, and anointing the body when rancid.

Regions where Oil is Produced.—While in the above sentences a brief abstract has been given of coconut oil, it is necessary to deal with this subject in greater detail. Enquiries are frequently addressed to the Government of India by merchants interested in the trade in this substance, so that it has become necessary to put on record as complete an account as can be collected from the scattered publications that exist, even should that prove but a statement of the littleness of our knowledge. One of the earliest and to this day the most satisfactory descriptions of the Indian coconut oil industry is that written by Lieutenant H. P. Hawkes and published in 1857. Gazetteer writers have contented themselves with treating the subject as too well known to call for any detailed description, and at most only the meagrest accounts have been given. To the merchant desirous of starting a new or extending an existing trade, the question of primary importance to which he calls for a reply is the province or district with which he should open up dealings. The chief products of the coconut are coir-fibre, oil, and toddy, or juice from which sugar and spirits may be prepared. We know that in Bombay the juice is largely extracted from the tree, that in Mysore the fibre is the chief preparation, and that in Madras and Travancore enormous quantities of both fibre and oil are exported; while Bengal, on the other hand, imports immense numbers of coconuts and a large quantity of copra, but exports very little of the products of the palm. It can nowhere, however, be discovered whether any two of these primary products or all of them can be derived from the same trees or even prepared by the same cultivators—certain plants or portions of the plantation being periodically set apart for these several industries. Under coir fibre it has been said that the green or unripe coconut is alone used for that purpose, while most writers seem to agree that the ripe kernel is necessary for the oil. It would be most instructive to know if cultivation had resulted in the production of certain races of coconuts famous for their oil-yielding properties, just as the inhabitants of the Laccadive Islands appear to have developed small-fruited one with a specially good fibre. In connection with commercial reports on coconut oil it is generally stated the finest qualities are obtained from "Cochin." (Spon places Cochin after Ceylon.) It will be recollected that this same statement occurs regarding the fibre derived (or supposed to be derived) from that Native State. The writer has failed to discover any account of the Cochin oil industry, and is almost forced to the opinion that by "Cochin coconut oil," as with "Cochin coir," may be meant the superior qualities of the oil derived from the Madras Presidency. If ripe coconuts are essentially necessary for the preparation of the oil, then the Maldive and Nicobar Islands might be looked to as the great seats of the oil industry. But while these islands export perhaps little short of from 15 to 20 million ripe coconuts a year, they do not appear to manufacture coconut oil, *and the ripe husks are of no use for fibre.* So, in a like manner, the Laccadives would not be looked to as a source of oil: these islands are famous for their coir, the inhabitants growing a peculiar coconut that would seem to be inferior to the Malabar either as an oil-yielding or an edible nut. The imports from the Maldives and Nicobar Islands into Madras are very unimportant as compared with those recorded against Bengal: yet Madras, and not Bengal, appears to control the coconut oil market. This fact would lead to the inference that the locally grown nuts of Madras were largely employed for the expression of oil—the very considerable imports from the Laccadives affecting mainly the coir industry. But if this inference be correct, there remains the difficult position that the ripe nuts, serviceable for oil-making, yield no fibre. The presumption would, therefore, appear to be that a very

much larger amount of the Madras coir comes from the Laccadive than we have any definite knowledge of at present, or that a large proportion of the coast cocoanuts or those of certain localities only are always or periodically set apart for oil-yielding. It may, of course, be the case that the trees are, so to speak, pruned by the removal for coir of so many green nuts from each tree, the remainder being allowed to ripen for oil purposes or as articles of diet.

This brief review, from want of definite information, may be accepted as indicating the direction that future reports might assume: but it may safely be concluded that, as with coir, so with cocoanut oil, Madras is the chief seat of the trade. Certain writers familiar only with Bengal (with the waving feathery clumps of cocoanuts dispersed through its suburban jungles, or surrounding its mango topes) have advocate the claims of the Lower Provinces as a future region of oil production. This would appear to be a pure hallucination which the enormous imports of ripe nuts should have prevented. It is extremely doubtful if Bengal is ever likely to do more than meet the local and internal demand for ripe nuts and oil. The European oil merchant, if he finds the suggestion impracticable which has been offered in an early paragraph—*viz.*, to call in the aid of the Maldive and Nicobar Islands—will do well to concentrate his attention on the Madras Presidency.

Mode of Preparation of the Oil.—The ripe kernel is cut out of the shell in various ways, and either dried by exposure to the sun or by artificial means. It is then known as copra (*khoprá*). Royle says:—"The Malabar method of making the oil is by dividing the kernels into two equal parts, which are ranged on shelves made of *laths* of the betelnut palm or split bamboo, spaces of half an inch wide being left between each lath. Under these a charcoal fire is lit and kept up for two or three days in order to dry them, after which they are exposed to the sun on mats, and when thoroughly dried, are subject to pressure in an oil press." Balfour remarks:—"The purest oil is obtained by gathering the kernel and depositing it in some hollow vessel, to expose it to the heat of the sun during the day, and the oil drains away through the hollow spaces left for the purpose." Hawkes states that "the oil is generally prepared for the dried kernel of the nut, by expression in the ordinary native mills." The *Gazetteer of Thána* mentions three processes of making the oil. The first giving origin to the oil there known as *khobrel*, is, as in the above quotations, a process of cold, dry expression. The method of drying is described thus:—"To make *khobrel* the kernel is taken from the shell by cutting the nut in half, called *káti*. After drying in the sun for a week the kernel is cut into thick pieces, which are crushed in the oil mill."

But a hot wet process is also adopted by which an oil is obtained which seems to possess different properties from that prepared by cold expression. The *Thána Gazetteer* describes two such oils: "To make *árel* the fresh kernel is scraped on an iron blade set in a wooden footstool. The scrapings are then put in a copper vessel over a slow fire, and after boiling are squeezed: sometimes instead of boiling them the scrapings are rubbed on a stone with a stone roller, and from time to time a little water is thrown over them. The scrapings are then squeezed and the juice boiled in a copper vessel, when the oil rises to the surface and is skimmed off. To make *naralel* dried kernels are cut into thick pieces and boiled in water. The pieces are then crushed in water and the whole is again boiled over a slow fire, when the oil rises to the surface and is skimmed off." It is worthily of careful observation that practically the difference between *árel* and *naralel* oil is that the former is made from fresh kernel instead of from copra. Dr. Shortt says: "Boiled oil is obtained by bruising the kopra or the fresh coconut, mixing it with an equal quantity of water, and then boiling the mixture. As the water evaporates the oil rises to the surface. It is poured off and the *débris* of the kernel is compressed by handfuls, so that any oil that remains may be extracted. Two quarts of oil are produced, on an average, from 15 to 20 nuts." In Borneo an oil expressed from the fresh coconut is used as a hair-oil, and is supposed, for that purpose, to be superior to oil obtained from copra. Hawkes says of the hot expression oil:—"When required for edible purposes, the kernel of the fresh nut is taken, rasped and mixed with a little boiling water. This yields by pressure a milky fluid

which, on being boiled until all the water has evaporated, produces a clear edible oil. Only just sufficient water to moisten the pulp should be added, as a larger proportion prolongs the operation and deteriorates the product. When fresh prepared, this oil is comparatively free from smell, but speedily acquires an unpleasant odour: many attempts have been made to divest the oil of this smell, which renders it inapplicable for the perfumer's use, but only with partial success." Nearly every writer describes a different mode of preparing the oil obtained by the hot moist process. The reader is referred to a further page where this subject will be found to be dealt with under the head of *The Oil as a Medicine*.

As far as the writer's personal experience goes, the bulk of the oil met within commerce is obtained by cold dry expression from copra or sun-dried kernel. There are no large mills for extracting the oil, but the crude oil-press used for oil-seeds generally, is employed, and every village in India has a few of these. They are accordingly to be found scattered not only throughout the coconut area, but even far into the interior where locally-produced or imported copra is expressed to meet the local demand for the oil. The production and consumption can then be judged of, and only approximately, by the foreign export and internal traffic in the oil; of the local production and consumption nothing can be learned, except that the oil is universally used by the bulk of the people of India for some purpose or other.

In the Jury Reports of the Madras Exhibition interesting information regarding the extraction and yield of coconut oil has been recorded. "Half a hundredweight of the dried kernel is a charge for a full-sized *checko*" (or country mortar-like oil-mill), and a pair of stout well-fed bullocks will get through four such charges in a day; so that twenty mills are required to get through two tons in the twenty-four hours. The man who drives has usually a boy to assist him in taking the oil, which is got out of the mortar by dipping a piece of rag into the fluid and squeezing it into an earthen vessel." So much oil do the coconuts contain that they are sometimes fixed on the end of poles and ignited for illuminations. For this purpose they are well suited, since both the fibrous husk and oil of the kernel burn brilliantly.

Properties of the Oil.—Coconut oil is a fixed fatty or greasy or non-drying oil, the specific gravity of which, according to Royle, is 0·892. When pure and freshly made it is of a pale-yellow colour, liquid in India, but having the consistence of lard in a temperate climate, and being then of a fine white colour. It becomes solid between 40 and 50 F. [according to *Spons' Encycl.*, it solidifies at 16 to 18 C. (*e.g.*, 61 to 64½ F.), and according to Shortt at "65 to 70 F.] and liquid at about 80 F. It has a bland taste, and a peculiar not disagreeable, odour. It is readily dissolved in alcohol. It consists mainly of a fatty principle designated *cocinin* with small amounts of *olein*. The *cocinin* when saponified with alkalies yields its glycerine and a *cocinic* acid (*cocostearic* acid, $C_{18}H_{28}O_2$). The oil has also been found to contain several solid and volatile acids, as *caproic*, *caprylic*, *capric*, and *pichuric* acid. (*U. S. Dispensatory.*) Dr. Dymock says that Oudemans regards the fatty principle as "a mixture of several glycerides. He has, moreover, shown that the fatty acid of the oil consists principally of *lauric acid* melting at 43° C., mixed *palmic acid* melting at 62° C., and myristic acid melting at 53·8° C. The oil also yields by saponification *caproic* and *caprylic* acids. It contains no *oleic* acid."

In *Spons' Encyclopædia* it is stated that "Its principal fatty acid is laurostearic, together with oleic, palmic, myristic and some others of less importance all combined with glycerine." One of the most remarkable features of this oil is that it will take up a large amount of water than any other commercial oil. This makes it eminently suitable for soap-making, and but for the smell which such soap leaves on the skin the oil would be even more extensively employed by the soap-maker than it is.

Industrial and Domestic Uses of the Oil.—This oil has now for many years been largely used in the candle trade. Messrs. Price & Co. introduced in 1840, on the occasion of Her Majesty's marriage (when for illumination a cheap self-snuffing candle was required), a new composite candle, which was a mixture of stearic acid and coconut stearine. This was subsequently greatly improved until at one time coconut oil was the chief feature of Price's patent candles. The immense improvements which have

taken place in the European candle industry have to some extent lessened the demand for the oil, but it is still largely employed. "It is an excellent illuminator, in both candles and lamps, as it emits no smoke."

Of no less importance is coconut oil to the soap-maker. "It forms a hard and very white soap, more soluble in salt-water than any other kind made on a commercial scale. During the last fifteen years its consumption for soap-making in England has been greatly reduced by the competition of palm-kernel oil extracted here." (*Spons'.*) Watt (*The Art of Soap-making*, 27) says of this oil: "It is extensively used in soap-making, especially for the inferior kinds of soap, and will bear a large admixture of water, in combination with silicate of soda and other substances, and yet form a hard soap. All soaps made with even a small percentage of coconut oil impart an offensive smell to the skin after washing with it. This oil is very extensively used in the manufacture of artificial mottled soaps, but more especially in the north of England, where enormous quantities of it are consumed annually." "One of the most important additions to the list of fatty matters, suitable for soap making, was the vegetable substance called *coconut oil* or *cocoa-butter*, which, from its extreme whiteness and capability of forming a hard soap, soon became an acceptable substitute in some degree for the more costly tallow. Soap made from this oil, or vegetable butter, is capable of taking up a larger percentage of water—and still forming a hard soap—than any other known fatty matter. The soap made from it, moreover, is more soluble in saline or hard waters, even sea-water, and from this reason it has long been made into soap called *marine soap* for use on board ship." The odour which it imparts to the skin or garment washed with it will last for several hours. The odour resembles that of infants' vomit. On this account it should never be added to the ingredients used in the manufacture of a toilet soap. It does not readily saponify with caustic soda leys by itself, but does so readily when mixed with tallow or palm oil.

A large amount of the native made soap used in India is prepared from this oil. This soap is made by boiling the oil with *dhobie's* earth, salt, saltpetre, quicklime, and water. The oil is also extensively employed by the richer people as lamp oil. It enters into the dietary of the mass of the inhabitants of India, and by them is largely employed to anoint the body or as a hair-oil; and variously-prepared forms of the oil are extensively used medicinally.

Prices and Yield of the Oil.—Speaking of the year 1851 Hawkes says: "The prices of this oil vary most considerably in different parts of the country. For quarter ending 31st October, the maximum and minimum prices at nineteen large stations in all parts of the Madras Presidency were R8-5-4 at Jubbulpore, and R1 14-0 at Bangalore, per maund. The average of 21 large stations in the presidency gives R4-9-5 per maund, or about £41 2s per ton. The market value of "Cochin oil" in London in January 1855 was £46 10s. per ton, the average being from £46 to £48." Further on he adds that the "Cochin is usually 20s. per ton more than the Ceylon or Coromandel coast article." Dr Dymock, in his last edition of the *Vegetable Materia Medica of India*, says: "The value of coconut oil in Bombay ranges from R16 to 20 per cwt."

The *Gazetteer of Kolhapur District* states that 48 lb. of dried copra yield 26 lb. of oil and 18 lb. of oil-cake. This would be about 54·1 per cent. of oil. Another writer puts the yield down at 36 per cent. There are so many different modes of preparing the oil that, apart from the possibility of there being superior and inferior oil-yielding forms of the plant, it must necessarily be difficult to fix definitely what may be regarded as the yield. It may, however, be accepted as somewhere between 30 to 50 per cent. Hawkes states that each tree is calculated to yield at least 2½ gallons of oil per annum, and the coir obtained from the nuts is estimated to yield one-fourth of the value of the oil, whilst the oil cake is very valuable for cattle as a manure." It will be observed the idea seems to be conveyed in the above passage that the coir from the ripe of copra-yielding nut is of value. No other writer appears to support this opinion.

Royle says that 2 quarts of oil may be expressed from 14 to 15 coconuts. *Spon's Encyclopædia* states that in the ordinary country oil-mill 180 lb. of copra will yield 40 quarts of oil, and that about 40 nuts required to yield a gallon of oil. The trees grown on salt marshes are stated to yield much less oil than those grown on mixed sandy and loamy soil.

TRADE IN COCONUT OIL.

Royle remarks that the imports into Great Britain of coconut oil were in 1850, 98,039 cwt., of which India furnished 85,096 cwt. Hawkes tates: "The average annual quantity exported from the Madras Presidency from 1850-51 to 1854-55 is about 1,410,963 gallons. Of this by far the largest proportion is sent to the United Kingdom and France, the remainder finding its way to Arabia, Mauritius, Bombay, and the French (Indian) ports." In 1850, as in the present day, the coconut oil trade almost entirely centred in Madras, so that the above passages may be taken as approximately indicating the extent of the foreign demand for the oil forty years ago. In 1880-81 the foreign exports amounted to 1,888,122 gallons valued at R20,90,797, Madras alone having shipped to foreign countries, 1,690,520 gallons, and sent in addition by coasting trade to other Indian ports, 1,493,756 gallons. In 1886-87 the exports were 1,099,861 gallons valued at R13,21,589, and the imports 556,562 gallons valued at R7,54,515. The bulk of the exports, (*viz.*, 689,087 gallons) went to the United Kingdom, Madras alone shipping 1,090,480 gallons of the total exports. The imports were mainly from Ceylon (138,141 gallons), Bengal taking by far the largest proportion of these imports (*viz.*, 350,437 gallons). If to these facts an abstract of the coasting traffic be added, some idea of the present position of the coconut oil trade may be had. The imports coastwise were last year 1,567,486 gallons valued at R20,60,067; the exports were 1,912,809 valued at R20,74,455. These were the amounts of the oil that went to and from the various ports of India; but the full meaning of these figures will be brought out by giving some of the particulars of this exchange. Of the imports, Bombay received 794,577, Burma 338,056, Bengal 131,163 gallons, and these quantities were almost entirely obtained from Madras. Cochin sent to Bombay 15,789 gallons and to Madras 13,188 gallons. The other items to make up the total coastwise imports were unimportant. Local production added to these imports would constitute the supply from which the exports could be made, and in the case of Madras it is noteworthy that that presidency imported particularly no coconut oil, so that her exports to foreign countries and to other Indian ports were drawn exclusively from local supplies. With the exception of the small amounts obtained from Cochin, Bombay, &c., and some 6,000 gallons from Ceylon and other foreign countries, Madras imported no coconut oil. But she exported 1,754,701 gallons, of which 1,008,621 went to Bombay, 273,347 to Burma, 191,413 to Travancore, and 155,202 gallons to Bengal. But Bengal exported coastwise 8,648 gallons and Bombay 3,151. The Bengal exports went to Burma and the Bombay to Sind, Madras, Goa, Kattywar, &c. Adding the foreign exports to the coastwise exports and deducting the total of the imports, we learn that Madras exported last year 3,125,221 gallons of coconut oil an amount which may be viewed as the surplus over local consumption. Turning to Bengal and Bombay, a very different state of affairs is found to prevail, the imports exceed the exports, in the former by 313,009 gallons and in the latter by 1,125,572 gallons. By these amounts the local production did not equal the consumption plus the internal trade from these presidencies. Coconut oil is thus a speciality of Madras trade.

COPRA OR DRIED KERNEL.

A very imperfect idea of the supply and demand for this oil would, however, be conveyed were we to omit to examine in this place the trade in copra or dried kernel, the substance from which the oil is expressed.

This is largely exported to foreign countries and sent from one province of India to another to be locally made into oil.

	1884-85.		1885-86.		1886-87.	
	Cwt.	R.	Cwt.	R.	Cwt.	R.
Imports	39,653	3,95,185	105,296	10,20,841	125,222	11,76,799
Exports	64,323	3,84,291	21,755	1,86,800	9,337	79,836

The imports come chiefly from Ceylon and the Straits Settlements, and are almost exclusively delivered in Bengal and Bombay, only very small amounts being received by Madras. The exports, on the other hand, go mainly from Madras (8,135 cwt. of last year's exports) Bombay being next in importance. The greater part of these exports (7,149 cwt.) go to Portugal, Persia, Ceylon, Russia, and Arabia, each receiving from 300 to 500 cwt. So far from the foreign traffic. The imports and exports coastwise have now to be considered. The total imports by coasting traffic were 347,255 cwt., valued at R35,31,115, and the exports 236,250 cwt., valued at R23,00,958. Of the imports, Bombay received 219,204 cwt., Bengal 62,971 cwt., Sind 31,658, Madras 27,025 cwt. Of the exports, Madras sent to other Indian ports 182,509 cwt., Bombay 53,295 cwt., Bengal exporting only 15 cwt. The balance between imports and exports will reveal, as with the traffic in oil, the fact that Madras is the great producing region, Bombay and Bengal receiving very much larger quantities than they export.

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OIL-CAKE OR PUNAC.—Before passing from the consideration of coconut oil, it is necessary to say something about the oil-cake. This is viewed as an exceedingly valuable manure, especially to coconut palms grown inland. It is also largely used to fatten fows, pigs, cows, and other animals. It is sometimes exported to Europe. In Madras it sells for 3 to 4 maunds (of 25 lb.) per rupee.

MEDICINE.

The green fruit is given as a refrigerant, the flowers as an astringent, and the oil employed as a substitute for cod-liver-oil. The milk of the nut, the juice from the flowering spike, and the tomentum from the leaves are all used medicinally.

WATER OR MILK FROM THE GREEN NUT.—"The water (or milk) of the unripe fruit is described as a fine-flavoured, cooling, refrigerant drink, useful in thirst, fever, and urinary disorders." (*U. C. Dutt.*) "It may be drunk to almost any quantity without injury, and is considered by the native doctors as a purifier of the blood." (*Ainslie.*) It is commonly believed in Bengal, however, that too much coconut milk induces a hydrocele swelling of the scrotum.

THE EDIBLE PULP AND THE MILK PREPARED THEREFROM.—The pulp of the young fruit is nourishing, cooling, and diuretic. The pulp of the ripe fruit is hard and indigestible but is used for medicinal purposes. Ainslie says: "scraping down the ripe kernel of the coconut and adding a little water to it, a white fluid is obtained by pressure, which very much resembles the milk in taste and may be used as a substitute for it." "Dr. Shortt reports having successfully employed the fresh milk—*i.e.*, the expressed juice of the grated kernel—in debility, incipient phthisis, and cachetic affection, in doses of from 4 to 8 ounces twice or thrice daily. It has a pleasant taste, and may be used as an excellent substitute for cow's milk in coffee; it may thus be advantageously administered even to children. In large doses it proves aperient, and in some cases actively purgative;

hence it is suggested by Mr. Wood as a substitute for castor oil and other nauseous purgatives."—(*Pharm. Ind.*, 247.)

The following is a prescription known in Hindu medicine as *Narikela-khanda*: "Take of the pounded pulp of coconut half a seer, fry it in 8 *tolas* of clarified butter, and afterwards boil in 4 seers of coconut water till reduced to a syrupy consistence. Now add coriander, long pepper, bamboo manna, cumin seeds, nigelle seeds, cardamoms, cinnamon, *tejapatra*, the tubers of Cyperus rotundus (*mustaka*) and the flowers of Mesua ferrea (*nága kesara*) 1 *tola*, each in fine powder, and prepare a confection. Dose 2 to 4 *tolas* in dyspepsia and consumption." (*U. C. Dutt, Hind. Mat Med.*, 248.)

THE SHELL.—"The cleared shell of nut or portions of it are burnt in a fire, and while red hot, covered by a stone cup. The fluid which is deposited in the interior of the cup is rubefacient, and is an effectual domestic remedy for ringworm." (*U.C. Dutt, p.* 248.) The *Bombay Gazetteer of the Thána District* alludes to this in the following words: "The shell when burnt yields an oil which is used as a cure for ringworm." "In the Antilles, the coconut is the popular remedy for tapeworm, and its efficacy has been conclusively demonstrated by medical men in Senegal. A coconut is opened and the almond extracted and scraped. Three hours after its administration a dose of castor oil is given. The worm is expelled in two hours afterwards. In nine cases in which this remedy was tried by a surgeon in Senegal the result was complete.—*Natal Mercury.*" (*Trop. Agri.*, 1882-83.)

THE OIL. A reference to the account given of the ordinary oil in another page will reveal the fact that there are three or four oils obtained from the coconut, or rather three or four methods of preparing oil from it which seems to give to the substance different properties. In the Thána district, for example, three oils are prepared from the edible portion or kernel of the nut. These are known as *khobrel*, *avel*, and *muthel*. A fourth oil is, however, repeatedly alluded to, namely, an oil prepared from the shell of the nut (*see above*). This last-mentioned oil is perfectly distinct from the oil of the kernel, and is used only in the treatment of ringworm. Its chemical properties have never apparently been determined, nor does it seem to have before this been pointedly made known to European medical authorities as a substance actually prepared and employed by the Indian doctors. It is remarkable that the same properties should be assigned to the shell by the inhabitants of other parts of the world besides India, although they do not apparently distil the oil from it. But of the kernel oils used medicinally, the most conflicting statements have been published both as to their action and mode of preparation. Thus: "A very cheap, hard white soap is prepared from the oil, suitable for pharmaceutical purposes, such as plaster making and the preparation of soap liniment." (*Dymock*). The *Pharmacopœia*, on the other hand, says this oil is inferior to ground-nut oil and sesamum oil as a vehicle for liniments. Sakharam Arjun remarks: "The fresh oil is prepared for medicinal purposes by boiling the milk of the ripe cocoanut. It is used as an application for burns and in baldness." Ainslie observes it is obtained by boiling the bruised kernels in water, or "on other occasions it is obtained by expression." Drury says: "The oil used internally for medicinal purposes is not the common commercial oil in its crude state, but the oleine obtained by pressure refined by being treated with alkalies, and then repeatedly washed and distilled with water." The therapeutic properties of the oil are discussed in the *United States Dispensatory*. "In Germany it has been used in pharmacy, to a considerable extent, as a substitute for lard, to which, according to Petten Kofer, it is preferable on account of its less tendency to rancidity, its more ready absorption when rubbed on the surface of the body, and its less liability to produce chemical changes in the substance

with which it is associated. Thus the ointment of iodine of potassium, when made with lard, becomes yellow in a few days, while if made with coconut oil it remains unchanged for two months or more. Vegetable substances also keep better in ointment prepared with this oil than with lard. Besides, it takes up one-third more water, which is a useful quality when it is desirable to apply saline solutions externally." "A preparation has been shown to us, said to be the liquid part of coconut oil, prepared in London, and, under the name of *coco-olein*, used instead of the oil itself, as a substitute for cod-liver oil. The dose of this, as well as of the oil, is half a fluid ounce three times a day."

The various processes adopted in India for preparing oil from the coconut result in the formation of substances that are reputed to possess widely different properties. This fact might almost be supposed to be in consequence of chemically different oils being isolated. Dr. Dymock says of the so-called *muthel* oil: "In the Konkan the oil which separates from the freshly-rasped kernel, alone or mixed with tamarind-seed oil, is used under the name of *mutel* as an application to burns and rheumatic swellings; sometimes black pepper is added to it." In the *Thána Gazetteer* a somewhat different process of preparing *mutel* (? *muthel*) oil is given. "To make *muthel*, dried kernels are cut into thick pieces and boiled in water. The pieces are then crushed in water and the whole boiled again over a slow fire, when the oil rises to the surface and is skimmed off."

Coconut oil is said to promote the growth of hair: "hence it is much used as a local application in alopecia, and in loss of hair after fevers and debilitating diseases. "The oil is given in plethora and as a vermifuge in Jamaica. It is given while fasting, warmed and with a little sugar, in flux. An emulsia of the oil and kernel is prescribed in coughs and pulmonary diseases generally. Pound the kernel with water, place it to settle, and skim off the cream. This is preferable to the expressed oil."

"Coconut oil was proposed by the late Dr. Theophilus Thompson (*Proceed. of Royal Society*, 1854, *Pt. III., p* 41) as a substitute for cod-liver oil; and in this character it has been favourably noticed by Dr. J. H. Warren (*Boston Med. and Surg. Journ., Vol III., p.* 377) and others. The substance used in these cases was not the ordinary commercial oil, but the oleine obtained by pressure from the crude oil (in the solid state it is met with in England), refined by being treated with alkalies, and then repeatedly washed with distilled water. In his Lethsomian Lectures Dr. Thompson gives the result of his treatment with this agent in 53 cases of pthisis. Of the first 30, 19 were much benefited, in 5 the disease remained stationary, and in the remaining 6 the disease continued to advance. Of the second 23, 15 were materially benefited, 3 remaining stationary, and 5 became worse. Dr. Garrod (*Brit and For. Med. Chir. Rev., Jan. 1856)* shows that it exercises a marked influence, almost equal to cod-liver oil, in increasing the weight of the body. The great advantage of its employment experienced by Dr. Thompson, Dr. Garrod, and also by the Editor, who instituted some trials with it is, that under its prolonged use it is apt to induce disturbance of the digestive organs and diarrhœa. Its use is favourably noticed in the Report of Drs. Van. Someren and Oswald, and Mr. J. Wood." (*Pharmacopœia of India*).

Dr. Dymock says coconut oil has been tried in Europe as a substitute for cod-liver oil, "but its indigestibility is a great drawback to its general use." Drury observes: "its prolonged use, however, is attended with disadvantage, inasmuch as it is apt to disturb the digestive organs and induce diarrhœa." May it not be that the unfavourable opinions formed by some writers regarding this medicinal oil proceed from the fact that

nearly every author describes a different mode of preparing it and consequently that it is possible many different substances or a substance in many stages of purity or impurity may have been experimented with? In the Maldives coconut oil is esteemed a powerful antidote against the bite of poisonous reptiles.

THE JUICE.—The freshly-drawn juice is considered refrigerant and diuretic, and is valuable as a preparation known as toddy poultice. The fermented juice constitutes one of the spirituous liquors described by the ancient writers. "A tumblerful of the fresh juice is sometimes taken early in the morning on account of its refrigerant and slightly aperient properties." (*Dymock.*)

SCRAPINGS OF THE HUSK.—"The outside scrapings of the husk and branches applied to ulcers will cleanse and heal them rapidly if soaked in proof rum; the efficacy of this application was proved by the case of two bad ulcers occasioned by the bite of a negro's teeth. The young roots boiled with ginger and salt are efficacious in fevers, the same as the bamboo." (*Royle.*)

THE COTTON OR TOMENTUM.—"This is a soft, downy, light-brown-coloured substance, found on the outside of the lower part of the branches of the coconut tree, where they spring from the stem, and are partially covered with what is called *punaday*, or coarse vegetable matting of the tree. The coconut cotton is used by the Indians for stopping blood, in cases of wounds, bruises, leech-bites, &c., for which purposes it is admirably fitted by its peculiar texture." (*Ainslie, Mat Ind.*) (Compare with Tomentum of *Caryota urens* and *of Borassus, B B. 680.*)

THE FLOWERS are sometimes used medicinally, being said to be astringent.

IMMATURE NUTS.—These, like the flowers, are often employed medicinally, especially as an astringent in the sore-throats of children.

THE ROOT.—"The root is used as a diuretic, as also in uterine diseases." (*U. C. Dutt, 248.*) It is also employed as an astringent gargle in sore-throat.

THE ASHES.—"The ashes of the leaves contain an amount of potash; they are used medicinally."

THE BUD. The tender buds of this palm, as also of *Borassus* and *Phœnix*, are esteemed as a nourishing, strengthening, and agreeable vegetable.

Special Opinions.— § "The husk of the fruit of the *Cocos nucifera* is used in the treatment of tapeworm. It is often as efficacious as the oil of male fern when taken on an empty stomach" (*Surgeon Major W. Nolan, M.D., Bombay*). "The juice of an immature fruit is used in acidity and gastric irritation. The volatile oil from the nut-shell is employed as a local application in ring worm" (*Civil Surgeon J. H. Thornton, B.A., M.B., Monghyr*). "Scraped coconut is used as an application in eczema of the scrotum. The milk of a young coconut drunk every morning is a popular domestic diuretic and diluent for very old men" (*Surgeon-Major John North, I.M.S., 1st Madras Cavalry, Bangalore*). "A black oil is extracted from the shell, and is used in itch and other parasitic affections" (*Surgeon Major R. Thomson, M.D., C.I.E., Madras*). "The coconut milk of the green fruit is a cooling, refrigerant drink, containing albumen and salines. It is a good drink in cholera cases. It succeeds in checking vomiting when other means fail. Coconut oil prepared from fresh pulp, is a good substitute for cod-liver oil. The dose I give is from 20 to 30 minims in the beginning, rising to a drachm thrice daily. An ash is prepared from coconut pulp by the *Koberajes* which is a valuable

ant-acid and digestive. It is called '*Narkel khoud.*' A sweet extract is also prepared, which is used for similar purposes" *(Civil Surgeon R. L. Dutt, M.D., Pubna).* "The sweet toddy obtained from this palm is very refreshing and possesses laxative properties. Its continued use (twice or thrice weekly) during pregnancy has a marked effect on the colour of the infant, which is born of a fair complexion, - *i.e.*, if of dark parents, comparatively fair; if of lighter-coloured parent, the offspring generally assumes a European complexion" *(Honorary Surgeon P. Kinsley, Chicacole, Ganjam, Madras Presidency).* "The milk of the green fruit is cooling and is giving to allay vomiting in bilious fevers. Coconut oil inunction has been found to be useful in tuberculous affection of the skin. It improves the general health like cod-liver-oil" *(Assistant Surgeon Shib Chunder Bhattacharji, in Civil Medical charge, Chanda Central Provinces).* "The water contained in the green fruit is anti-emetic and soothing" *(Civil Surgeon D. Basu, Faridpur).* "Preserved coconut (*Nariker khondo*) is used by the *Kobirajes* as an alterative in cases of chronic heartburn and phthisis pulmonalis" *(Assistant Surgeon Anund Chunder Mukerji, Noakhalli).* "The oil is extensively used to fatten and is given for phthisis" *(Surgeon-Major Lionel Beech, Cocanada).* "An excellent substitute for cod-liver oil; very much used here" *(Civil Surgeon C. J. W. Meadows, Barrisal.)* "The oil promotes the growth of the hair" *(Civil Surgeon J. Anderson, M, B., Bijnor).* "The oil is considered to increase the growth of hair and render it black *(A Civil Surgeon).* "If the flowers are mixed with sugar, the root of *khus-khus* and white *chandan*, with a little water, the combination will be found good in bilious fever, will check vomiting, and produce a cooling sensation" *(Civil Surgeon William Wilson, Bogra).* Useful "in dysentery, diarrhœa, menorrhœa, and stomatitis" *(Native Surgeon T. Rathnam Moodelliar Chingleput, Madras Presidency).* *C. mamillaris*, dwarf coconut tree, Pemba, East Africa: fruit large, smooth, distinctly three-cornered: pinkish yellow when ripe: without the fibrous pericarp of the common coconut. Yields very little oil, but supplies a refreshing drink in fevers and in hot weather, and is said to produce free diuresis: used when the nut is full grown, but before it begins to ripen. *Vern.* of East Africa, *Muazi. C. unci fera*; *Muazi-go* Pemba. *C. mamillaris* *(Surgeon-Major John Robb, M. D., Surat, Bombay Presidency).*

COCONUTS.

Under the head of food products obtained from this palm we may note the following:—

Coconut Cabbage. - This is the terminal bud at the summit of the tree, It is used as a vegetable and also makes an excellent pickle, but to obtain it the palm is killed.

Young Coconut (Vern. *dab*). - This is the tender fruit, plucked off the tree for the cooling, sweetish, clear water, and the soft, cream-like pulp it contains. The water is drunk and the pulp eaten by natives of all classes.

Mature Coconut (Vern *jhuna narkel*).— This is the fruit in its mature state, with its outer, thick, fibrous covering completely dried. It contains less water, but has a thicker and harder albuminous layer than the tender fruit; when dried this albuminous substance is known as copra. It is eaten with parched rice, or rasped and put into curries or made into sweetmeats. Copra is either allowed to ripen and dry within the shell, when it separates naturally and is removed entire, or the shell is broken and the copra cut out and dried either in the sun or over fires. The former exists in large pear-shaped pieces smaller than, but of the same shape as, the interior of the nut, and is known as "natural copra." The

latter occurs as the irregularly-cut pieces known as "artificial copra." An oil is extracted from copra which is employed for various culinary purposes, and is also exported to a certain extent. (For further particulars regarding copra see under the chapter Oil.)

Juice.– The coconut also yields a juice from the flowering spike which may be drunk in its fresh state –*toddy*; or fermented and distilled– *arrack*; or boiled down to sugar and eaten as– *jaggery*.

The Root.–This is said to be chewed like arecanut with betel-leaf in *pán*.

THE NUTS.

The above is a brief abstract of the food-products of this palm. The extent to which the unripe fruit is eat, the water and unripe kernel being consumed and the husk made into coir, may be partly inferred from what has been already said regarding the fibre. To a large population in India the coconut is almost a staple article of diet.

TRADE IN COCONUTS.–The trade in the ripe coconut is very extensive. We have repeatedly alluded to this in the foregoing remarks, and may rest satisfied by briefly reviewing here the main facts of the foreign and coasting trade in these nuts, as recorded in Mr. J. E. O'Conor's Statement of the Trade and Navigation of British India.

Foreign. In the year 1886-87 India imported from foreign countries ripe coconuts to the number of 15,596,918, valued at R5,98,203; she exported to foreign countries 275,230 nuts, valued at R8,462. Of the imports to India the Maladives sent 7,867,453, the Straits Settlements 5,542,758, Ceylon 1,434,821, East Africa 627,346. Of the imports Bengal took 8,130,229 valued at R1,75,552, Burma 5,618,919, valued at R3,72,702, Bombay and Madras each received 700,000, and Sind 86,800. Bengal exported no coconuts to foreign countries, but Bombay and Madras each sent about 150,000 to Egypt, Arabia, and Turkey in Asia. The foreign trade in ripe coconuts is therefore very unimportant, and but for the Maldives being viewed as foreign territory (while the Laccadives and Nicobar Islands are not), it would be scarcely worth notice. It is noteworthy that India at present takes practically no part in meeting the English market. The passage already quoted from Mr. Jackson's paper in the *Planter's Gazette* conveys some idea of the magnitude of the British demand. Speaking, however, of the extent to which the nuts are eaten or made into confectionery, he continues: "Coconuts are largely used in the north and west of England, and they are also in great demand at holiday times, at fairs, on race-courses, and such like gatherings in all parts of the kingdom." He also remarks that the Trinidad nuts are considered the sweetest in flavour, and are mostly preferred by the confectioners and bakers, though the Ceylon run them close.

Indian.–The coastwise trade or interprovincial exchange, is, however, very important. The total imports from one port to another were last year 91,756,319 nuts, valued at R21,21,911 and the exports 68,938,032, valued at R16,88,773. Of the imports Bengal received 2,998,617, Bombay 77,984,733, Sind 1,172,819, Madras 5,511,718, and Burma 1,058,462. The imports into Bengal and Burma were largely from the Nicobar Islands and into Bombay from Madras (17,268,590) from Goa (18,825,703), and from ports within the Bombay Presidency, while the imports into Madras were from other ports within the presidency (5,162,351), presumably a large proportion of which were from the Laccadives.

Of the coastwise exports in 1886-87 Bengal sent to Burma, according to one official table of coastwise trade, 1,676,773, but according to another only 6,890. Bombay, in addition to its exchanges between its own ports, sent considerable numbers to Sind, Kattywar, Cutch, Cambay, &c, Madras gave more than three-fourths of its coastwise exported nuts to Bom-

bay, with a little over a million nuts to Bengal, the same number to Burma, and 2,591,475 to Cutch. Burma exports no coconuts, but it seems probable that some of its imports, which appear as from Bengal, may be from the Nicobar Islands. These islands being associated in trade returns with Bengal, direct exports may occasionally not appear as exports from Bengal; hence, in all probability, the disparity in the figures of imports into Burma alluded to above.

JUICE FROM THE COCONUT.

Dr. Hugh Cleghorn has described as follows the process of tapping the palm for its juice in Madras—a process which is essentially that followed in Bombay and other parts of the country: this palm is not tapped in Bengal. When the spathe is a month old, the flower-bud is considered sufficiently juicy to yield a fair return to the (*Sánár*) toddy-drawer, who ascends the tree with surprising ease and apparent security, furnished with the apparatus of his vocation. A year's practice is requisite before the Sánar becomes an expert climber. The spathe when ready for tapping is 2 feet long and 3 inches thick. It is tightly bound with strips of young leaves to prevent expansion and the point is cut off transversely to the extent of one inch. He gently hammers the cut end of the spathe to crush the flowers thereby exposed and to determine the sap to the wounded part, that the juice may flow freely. The stump is then bound up with a broad strip of fibre. This process is repeated morning and evening for a number of days, a thin layer being shaved off on each occasion, and the spathe at the same time trained to bend downwards. The time required for this initiatory process varies from five to fifteen days in different places. The time when the spathe is ready to yield toddy is correctly ascertained by the chattering of birds, the crowding of insects, the dropping of juice, and other signs unmistakeable to the Sánár. The end of the spathe is then fixed into an earthen vessel called *kudave*, and a slip of leaf is pricked into the flower to catch the oozing liquor and convey the drops clear into the vessel. When the juice begins to flow the hammering is discontinued. A single spathe will continue to yield toddy for about a month, during which time the Sánár mounts the tree twice a day and empties the juice into his *cropetty* (a vessel made of closely-plaited palmyra fibre), and repeats the process mentioned above of binding and cutting the spathe an inch lower down, and inserting its extremity into the *kudave*. The flow is less during the heat of the day than at night. One man will thus attend to 30 or 40 trees. Forty trees will yield about 12 Madras measures (1½ to 2 gallons) of juice—7 measures in the morning and 5 in the evening. This is at the rate of about a quarter of a measure per tree. The length of time a tree will continue to yield varies from six months to a year in very favourable soil. But it is not considered prudent to draw all the juice one can from a tree, as it will then become barren all the sooner. Dr. Shortt says the quantity of sap a tree will yield varies according to locality and the age of the spathe; 3 to 4 quarts is the average quantity obtained in 24 hours for a fortnight or three weeks. "Sometimes this fluid is converted into what is termed *mire* by lime-washing the vessels that collect the fluid in order to neutralise the acidity. It is then sold as a sweet and refreshing drink in the bazaars.'. "Toddy," he proceeds to say, "is also boiled down into a coarse kind of sugar called *jaggery*, which is converted into molasses for the manufacture of spirits, or refined into white or brown sugar before fermentation sets in."

In Bombay the coconut palm is tapped for its juice in Ratnagiri (*Gaz., X., 31*), in Kolába (*XI., 28*), in Khándesh (*XII., 321*), in Thána (*XIII., Part I., 295*), and in Kánara (*XV., Part I., 58*; *Part II., 205*). According to the returns the writer has had access to, there are some 3½ million trees in Bombay, of which about 30,000 to 40,000 are tapped for their juice.

The following abstract from the *Kolába and Ratnágiri Gazetteers* may be accepted as fairly representing the process of tapping pursued in Bombay, the yield, rent paid, return and profit being there shown. The coconut gardens are generally owned by Hindus, who let the trees to rich Bhandáris, who agree to supply the owner of the liquor shops with fermented or distilled juice. From the very earliest times coconut trees have been taxed, a distinction being made between trees kept for fruit and those set apart to be tapped. In the Ratnágiri district, it is stated, toddy trees let at from 2*s.* to 6*s.* (R1 to R3) a year. In addition to rent, a Government tax on trees tapped has to be paid. The maximum leviable rate was in Malabar and Deogad 2½*d.* (1 anna 8 pie) a month or 2*s.* 6*d.* (R1¼) a year on each tree tapped. Under the new system a special license is granted to tap trees, at a fixed rate for each tree, and under certain conditions as to the number of trees included in the license. The licensees are allowed to sell toddy by retail at the foot of the trees, but not to distil, the latter privilege being vested exclusively in the licensed shop-keepers for the sale of country spirit. In Kolába, it is said, the crude juice of fifteen trees costs the Bhandári about £1-2*s.* (R11) a month or 1*s.* 6*d.* (12 annas) per each tree. Besides the wages of the distiller and cost of fuel the Bhandári has to make good to the liquorshop keeper part of the tapping tax he had paid to Government. Government levies from the liquor-shop keepers £60 (R600) a year for every hundred trees tapped. Three-fourths of this the liquor-shop keeper pays; the remaining fourth he recovers from the Bhandári who supplies the liquor. The Bhandári's share of tax amounts to £15 (R150) on one hundred trees for one year, that is, a monthly charge of £1-5*s.* (R12½) on the one hundred trees, or on each tree a monthly tax of 3*d.* (2 annas).

In Ratnágiri the yield is said to vary from 35 to 64 imperial gallons from each tree. In Kolába a tree is said to yield on an average 4½ pints (1¾ seers) of juice a day, or 10½ imperial gallons a month. The juice is seldom sold raw: most of it is distilled by the Bhandári and sold by him to the liquor-shop keeper. With the wages of an assistant the monthly charge for distilling the produce of one tree is about 2*d.* (1¼ annas). The cost of fuel is about 6*d.* (4 annas) more, or about 8*d.* in all. Distilling lowers the quantity of liquor by about one-half,—that is, it reduces the average monthly outturn of each tree from 10½ to 5¼ gallons of spirit. Taking everything into consideration, tapping, distilling, &c., the Bhandári pays about 2*s.* 5*d.* (R1-3-3) for the produce of each palm. Allowing for loss by estimating, instead of 5¼, only 5 gallons, he obtains 3*s.* (R1-8) for the spirit prepared from each palm. This leaves him a net profit of 7*d.* (4½ annas) on each tree, and if he possesses a plantation of 300 trees he makes a fairly good income.

Of Ratnágiri, it is said, there are ordinarily three kinds of palm spirit, known respectively as *rási*, *phul* or *dhurti*, and *phéni*; *rási* being the weakest and *phéni* the strongest. In some places a still stronger spirit called *duvási* is manufactured. The average wholesale rates at which the farmers buy stock from the manufacturers are for the imperial gallon, *tádi* 2¾*d.* (1 anna 10 pie), *rási* 8¾*d.* (5 annas 7 pie), *phul* 1*s.* 1½*d.* (8 annas 9 pie), *phéni* 2*s.* 6¼*d.* (R1-4-6), and *duvási* 4*s.* 9¼*d.* (R2-6-1). The spirits are distilled in private stills, licensed to be kept at certain Bhandáris' houses under fixed conditions as required, in proportion to the number of trees licensed to be tapped in the vicinity. One still is usually allowed for every 100 trees, and the still-pot is limited to a capacity of 20 gallons.

FERMENTED AND UNFERMENTED BEVERAGE.

This is one of the forms of the so-called palm-wine so much extolled by the early European visitors to India. From what has been said in the preceding pages regarding the juice it may have been inferred that, if left for a short time after removal from the tree, it rapidly ferments

and becomes intoxicating. This is the *tari* or toddy (or in the case of the coconut more specifically known as the *nira*), a beverage very extensively consumed in India. Fermentation is said to be prevented by the addition of a little lime to the fluid. The earthen vessels into which it drains are generally powdered with lime when the fluid is to be drunk in its fresh unfermented state, or is intended to be boiled down to sugar or *jaggery*. It is also drawn early in the morning instead of being left on the tree overday. Robinson says of the Laccadive islanders that "they are still so strict in the abstinence from all fermented liquors, that the manufacture of toddy would not be tolerated in the islands." Self-fermented toddy is extensively used by the bakers in India in place of yeast. When fermented the juice may be distilled into spirits or made into vinegar. One hundred gallons of *tari* yields on an average twenty-five of *arrack* by distillation.

PALM SUGAR.

Instead of being fermented, the liquor may be evaporated down and its sugar thus extracted. "Eight gallons of sweet toddy, boiled over a slow fire, yield 2 gallons of a lusciously-sweet liquid, which is called *jaggery* or sugar-water, which quantity being again boiled, the coarse brown sugar called *jaggery* is produced. The lumps of this are separately tied up in dried banana leaves" (*Royle*). Dr. Shortt says: "The sap is poured into large pots over an oven, beneath which a strong wood-fire is kept burning, the dead fronds and other refuse of the plants being used as fuel. The sap soon assumes a dark-brown semi-viscid mass, well known as *jaggery* or *gúr*, which whilst warm is poured into earthen pots or pans for preservation. Ten to twelve seers of the sap yield one of *jaggery*: the value of a maund of this *jaggery* is about 2 rupees. In this state it is sold to *abkari* contractors, sugar refiners, or merchants. The sugar refined comprises several sorts, known in the market as moist, raw, coarse, and fine sugar. The *jaggery* is placed in baskets and allowed to drain; the watery portion or molasses dropping into a pan placed below. This is repeated, so that the *jaggery* or sugar becomes comparatively white and free from molasses. This sugar—for so it may now be called—is put out to dry, and the lumps broken up; when dry it is termed raw sugar, and weighs about 25 per cent. of the whole mass, the rest of being collected in the form of molasses." Thus coconut sugar is chiefly met with in the form of *jaggery*. It is well-known, however, that it is capable of being refined, according to European principles, and a certain amount of coconut sugar is regularly prepared. "The success of Dr. J. N. Fonseca (author of the *History of Goa*), in converting toddy of the coconut tree into crystallized sugar, has been hailed with satisfaction by the press at Goa, and flattering calculations are made of the advantages that will accrue to the country from the development of this new industry" (*Bombay Gazette*). A Similar sugar is prepared from the date-palm, from the palmyra-palm, and from the Indian sago-palm (*Caryota urens*). The date-palm is very largely used for this purpose in Bengal, and the coconuts and palmyra palms in Madras, while in Bombay, apparently, sugar is only very occasionally made from the juices of these trees, but when extracted it is most generally prepared from the palmyra or Caryota palms. Some years ago the Government of Bombay, getting alarmed at the growth of the habit of toddy-drinking, brought Jessore sugar manufacturers to try the experiment of preparing sugar from the date-palms of the western presidency. According to the returns of the Surat district there are in that district alone 1,195,901 date-palm trees, of which 489,395 were tapped in 1867-68. But was found that the returns from sugar manufacture were so poor, as compared with the profits from the sale of *tari*, that the experiment practically failed. It is not known whether or not sugar to any appreciable extent is actually prepared from the Bombay palms, nor even whether a license is necessary to tap trees for sap intended to be so used. Of the Thana district it is

said: "Coarse sugar or *gúl* is also made by boiling the juice in an earthen pot over a slow fire." It is worth recording that according to the Gazetteers there are 3,500,000 coconut trees in Bombay, of which 50,000 are regularly licensed. Of Palmyra palms there are said to be 17,810 trees in Surat alone of which 16,739 are regularly tapped. Of Caryota palms there are 70,000 trees, of which about 20,000 are tapped; 48,900 of these occur in Káuara, 21,672 in Kolába, and the remainder in Ratnágiri.

In a recent report on the trade in Indian sugar issued by the Revenue and Agricultural Department, no mention is made of palm sugar being prepared in Bombay, so that it may be inferred the trees licensed to be tapped are employed entirely in the supply of toddy. It is noteworthy, in passing, that it should pay the Bengal and Madras people to make sugar from the palm juice, while it is viewed in Bombay as unprofitable to do so. Turning to Madras it will be found that the report on sugar alluded to above gives the area under the sugar-yielding palms in 1881-82 as

	Acres.
Palmyra	24,900
Coconut	5,700
Date	1,500
	32,200

The writer of that Report adds: "In 1884-85 and 1885-86 the area under coconut, date palms, and palmyras was 31,000 and 28,000 acres respectively, and the outturn 22·60 lakhs maunds and 19·98 lakhs maunds. The total quantity of jaggery produced from coconuts, &c., is apparently more than that obtained from sugar-cane." In a special report on the coconut issued by the Revenue and Agricultural Department in 1886 it was estimated that there were 77,765 acres under that palm. Taking the customary estimate of 100 trees to the acre, we arrive at the conclusion that out of a total of 7,776,500 trees, 570,000 were tapped, or perhaps only tapped for sugar, others being tapped for toddy. There exists in all the works and reports the writer has been able to consult the greatest possible confusion as to whether or not the trees may be tapped for sugar without paying the license levied on the tappings made with the view to the preparation on the beverage. It would be instructive to know if the 5,700 acres of coconuts in the above statement of Madras are exclusively set apart for sugar, and are independent of the trees spoken of in excise reports as licensed for the preparation of toddy. If every tree tapped has to pay the heavy tax imposed on the preparation of the toddy, it might fairly be inferred that the failure to develope a palm-sugar industry proceeded to some extent from that fact. But there are many other difficulties to the creation of a large trade in palm sugar. In this respect the following passage will be found instructive:—

"From time immemorial (*sic*) the natives of Ceylon have known how to produce crystallized sugar from the inspissated juice of the coconut spathe. About thirty years ago, in consequence of a letter from the late Mr. J. Glanville Taylor, of Batticaloa, asking for information as to the probable success of attempting to utilize coconut palms for sugar-making, we went fully into the matter, receiving considerable assistance from Mr. D. C. Amerasekere, a proctor who, when we last heard of him, was practising at Kurunegala. On that occasion he sent us a quantity of crystallized coconut tree sugar, which, however, was somewhat discoloured by smoke.

* De Candolle, quoting from Seeman, says, upon a rock near Point-de Galle may be seen "the figure of a native prince, Kotah Roya, to whom is attributed the discovery of the uses of the coconut, unknown before him; and the earliest chronicle of Ceylon, the *Mahawansa*, does not mention this tree, although it carefully reports the fruits imported by different princes."

The result of our enquiries was that, although the juice when collected was rich in saccharine matter, yet the cost of collection would render the enterprise unprofitable. What pays natives on a small scale will not pay Europeans when the matter is entered into on commercial principles. An experiment might be tried, however, labour being economised by the use of ladders, perhaps, and a larger use than the natives make in toddy drawing of safe passages from tree to tree." (*Tropical Agriculturist*, 1882-83, 568.)

CEMENT MADE OF LIME AND COCONUT JAGGERY.

So often is this subject alluded to that it deserves special notice. The practice seems to prevail through Southern and Western India, but is apparently not followed, more likely unknown, to the natives of Bengal. In the *Thana Gazetteer* it is stated: "Mixed with lime, this palm sugar makes excellent cement." Drury remarks: "This jaggery is mixed with *chunam* for making a strong cement, enabling it to resist great heat and to take a fine polish." "The water of the nut is used by the bricklayers in preparing a fine whitewash, also in making the best and purest castor oil, a certain proportion of it being mixed with the water in which the seeds are boiled."

In *Spons' Encyclopædia* there occurs the following regarding Ceylon jaggery: "Amongst a variety of purposes to which it is put is that of being mixed with the white of eggs and with lime from burnt coral or shells. The result is a tenaceous cement, capable of receiving so beautiful a polish that it can only with difficulty be distinguished from the finest white marble."

This subject appears to be well worthy of chemical investigation, for there seems every reason to presume that the property of this ingredient in combination with lime might, with great advantage, be employed to replace the whitewashes commonly used, to the injury of the garments of whoever may lean against walls so coloured. *(Conf. with opening sentences under Domestic Uses, and the account given under* Dye, C. 1547.*)*

PALM SPIRIT OR ARRACK.

Instead of being consumed as a fermented beverage the palm wine may be distilled, thus forming palm spirit or arrack. As no separate record is kept of the coconut from the other palm spirits, we shall rest satisfied with what has been said regarding the trees licensed to be tapped. Under Spirit will be found further particulars regarding the method of taxation and process of distillation generally pursued. The present notice of coconut spirit may therefore be concluded by the following note kindly furnished for this work:—

"Dr. Lyon, of Bombay, has recorded some interesting details regarding the alcoholic strength of toddy from the coconut, date and brab. In the following table is shown the average alcoholic strength of six night-collected samples of each of the three kinds of toddy at respectively three and eight hours after collection, and the average maximum alcoholic strength attained by the samples; as well as the strength of samples collected during the twelve day-hours, when examined the morning after collection:—

	Proof spirit per cent		
	Coconut.	Date-palm	Brab (Borassus.)
Night Samples.			
3 hours after collection	7·15	5·8	3·9
8 " " "	10·0	8·0	4·7
Maximum strength	11·9	11·0	7·9
Day samples.			
15 hours after collection	10·8	11·7	6·5

"Dr. Lyon finds that in toddy collected in pots which have previously been used, fermentation commences before the pots are removed from the tree. The toddy appears to attain its maximum strength within 24 hours after removal from the tree. The volume of toddy yielded is greater during the twelve night than twelve day hours. Comparing trees of the same class, a yield of toddy above the average is, as a rule, accompanied by attainment of alcoholic strength above the average. The rapidity of fermentation and yield of alcohol varies for different samples. (*Chemical Examiner's Annual Report, Bombay.*)"—*Prof. C. Warden, Calcutta.*

The reader is referred for further particulars to *Borassus flabelliformis* (*B. 683*), *Caryota urens* (*C. 714*), to *Narcotics*, to *Phœnix sylvestris* and to *Spirits*.

Vinegar from Palm Wine. Nearly every writer who has dealt with the subject of the useful products of the coconut alludes to the vinegar prepared from the juice. "One hundred gallons of toddy produce by distillation, it is said, twenty-five of *arrack*. Or it may be allowed to undergo the acetous fermentation and produce very good vinegar. Or instead of being allowed to ferment, the toddy may be made to yield *jaggery* or sugar. For this purpose a supply of sweet toddy is procured mornings and evenings, particular care being taken that the vessels employed have been well cleaned and dried." (*Royle, Fib. Pl.*)

The vinegars prepared from the juice of the various palms that yield such juices do not appear to have been carefully examined. The natives of India attribute peculiar properties to each.

STRUCTURE OF THE WOOD.

Outer wood close-grained, hard, and heavy. Vascular bundles black or dark purple, closely packed in the outer part of the stem or horizontal section, circular or uniform, enclosing vessels and cells.

The wood is commercially known as "Porcupine wood;" it is used for rafters and ridge-poles, house-posts, and other building purposes; for spear-handles, walking sticks, and fancy work. When freshly cut "it possesses great elasticity, and is for this reason particularly well adapted for temporary stockades which are exposed to cannon-shot." (*Drury.*)

DOMESTIC AND SACRED USES.

So many of these have already been alluded to that it is scarcely necessary to attempt to enumerate the thousand and one uses to which the palm is put by the people of India. Under sugar or *Jaggery* on the opposite page will be found a brief notice of the very interesting uses of the juice and milk in the preparation of polishing cements. This art is much practised in Madras, the smooth shining wall-plasters being much admired. By Hindus, the dried shell is almost universally used as the water-bowl of their smoking-pipes or *hûkah*. In Madras these shells are made into elegantly-carved ornamental vases, lamps, spoons, sugar-pots, teapots, &c. Coconuts are largely employed as offerings to the gods by the Hindus, and coconut day (the full moon in August) is celebrated throughout the country. Entire shells are obtained by filling them with salt water and burying them in the sand for a time. By this process the kernel is destroyed and may be washed out. If thoroughly ripened before being treated in this manner, the shell will keep for many years: if not, it will soon rot. The dried kernel is sometimes cut into ornaments such as flowers or garlands; these are worn by Hindu women. The following extract gives a graphic account of the manner in which the coconut enters into the everyday life of the people of the tropics:—

Dickens in *Household Words* says:—"To a native of Ceylon the coconut palm calls up a wide range of ideas; it associates itself with nearly every want and convenience of his life. It might tempt him to

assert that if he were placed upon the earth with nothing else whatever to minister to his necessities than the coconut tree, he could pass his existence in happiness and content. When the Sinhalese villager has felled one of these trees after it has ceased bearing (say in its seventieth year), with its trunk he builds his hut and his bullock-stall, which he thatches with its leaves. His bolts and bars are slips of the bark, by which he also suspends the small shell which holds the stock of home-made utensils and vessels. He fences his little plot of chillies, tobacco, and fine grain with the leaf-stalks. The infant is swung to sleep in a rude net of coir string made from the husk of the fruit; its meal of rice and scraped coconut is boiled over a fire of coconut shells and husks, and is eaten off a dish formed of the plaited green leaves of the tree with a spoon cut out of the nut-shell. When he go a-fishing by torch-light, his net is of coconut fibre; the torch, or *chule* is a bundle of dried coconut leaves and flower-stalks; the little canoe is a trunk of a cocoa-palm tree, hollowed by his own hands. He carries home his net and his string of fish on a yoke, or pingo, formed of a coconut stalk. When he is thirsty he drinks of the fresh juice of the young nut; when he is hungry he eats its soft kernel. If he has a mind to be merry, he sips a glass of arrack, distilled from the fermented juice of the palm, and dances to music of rude coconut castanets; if he be weary he quaffs 'toddy,' or the unfermented juice, and he flavours his curry with vinegar made from this toddy. Should he be sick, his body will be rubbed with coconut oil; he sweetens his coffee with *jaggery* or coconut sugar, and softens it with coconut milk; it is sipped by the light of a lamp constructed from a coconut shell and fed by coconut oil. His doors, his windows, his shelves, his chairs, the water-gutter under the eaves, are all made from the wood of the tree. His spoons, his forks, his basins, his mugs, his salt-cellars, his jars, his child's money-box, are all constructed from the shell of the nut. Over his coach when born and over his grave when buried, a branch of coconut blossoms is hung to charm away evil spirit." This is, of course, a European picture, some of the illustrations being scarcely in accordance with fact. It is, however, a true picture of the all-importance of the "Prince of Palms" to the inhabitants of the tropical regions.

In order to convey some idea of the numerous uses of the coconut palm,' the following extract from the Colonial and Indian Exhibition Catalogue may be here reproduced, It is a list of certain articles prepared from the palm, exhibited by Mr. M. C. Pereira, Head Assistant to the Government Medical Storekeeper, Bombay :—

(1) COIR (*Kábál Kaithá.*)—The fibre made of coconut husk; in this state it is used for stuffing cushions, pillows, beds, making rope-mats, &c.

(2) SPOON *(Ulki).* Used in the cook-rooms of Europeans, and by the natives for drinking gruel (rice *conji*); has the advantage over the metallic one of not being corroded.

(3) DRAINER *(Zárâ).*— Used for draining food fried in *ghi* (clarified butter) or oil.

(4) LADLE (*Doho*).—Used for water.

(5) LADLE, SMALL (*Buddi*).—Used by natives for taking out oil for daily use from an earthen vessel containing the yearly or quarterly stock. It is not corroded by the oil.

(6) HUBBLE-BUBBLE (*Gudgudi*).—This is the *hukah* of the poorer classes.

(7) BEADS (*Mani*).

(8) VINEGAR (*Sirká Amti*).—Made of the juice (*toddy*) of the coconut palm.

(9) PICKLE (*Loncha, Achár*).—Made of the pith of the top of the fresh tree with vinegar of the juice (*toddy*) of the same palm.

(10) (*Pogi*)—The spathe of the blossom.

(11) RIB (*Kadi Hirkute*).—The rib of the leaf.

(12) BROOM, GOA (*Kersuni, Butará, Zadu*).—Made of leaf-ribs; it is much used for sweeping purposes.

(13) STRAINER (*Mandorá*). The sheaths by which the leaves are held firm to the tree. Used for straining coconut juice (*toddy* and coconut milk, and for general straining in the cook-room.)

(14) WOOLLY FLOSS (*Burá*). Much used as a styptic for cuts by the *toddy* drawers and cultivators.

(15) BLOSSOM (*Kontí*). The blossom in the state when it is tapped for drawing juice (*toddy*).

(16) CHAIN (*Sankli Kargoto*).—Used round the waist to retain the lion cloth. The size is for a child. Set in metal may be used as a watch-guard.

(17) DRUM (*Dholki*).—Made of a piece of the trunk of the coconut tree.

(18) WOOD PIECE OR RAFTER (*Barod Wánsa*). Made of the lower part of the tree 10, 20, and 25, feet in length.

(19) OIL (*Khobrel*).—Oil expressed in the native mills for commerce.

(20) OIL (*Mathel*).—Oil extracted from fresh coconuts by rasping fine, drying, and pressing between coir and twisting with hands or by extracting the milk and separating the oil by heat. Used internally in lieu of cod-liver oil and externally for ulcers with good results.

(21) HAIR OIL. Coconut-hair oil.

(22) LIQUOR (*Daru, Rashi Crakh*).—Spirituous liquor 60° U. P. distilled from coconut juice (*toddy*) and drunk hot.

(23) PUNCH (*Queimádo, Portuguese name*). The punch is made of the liquor of the coconut palm with spices and sugar from the receipt of the Portuguese. There is no native name for it, and it is only known to the Native Christians of Bombay. Drunk hot for a cold, one or two cupfuls.

(24) LIQUOR (*Fhenidárá Port Dobrado*) (*double*).—Liquor made of coconut (*toddy*) juice by redistillation 20° U.P.; formerly much used for making medicinal tinctures and country brandy.

(25) COCONUT (*Náred.*) This fruit takes a year to ripen.

(26) SWEETMEAT (*Nárlipak*). Prepared from the kernel of the nut.

(27) SWEETMEAT.—Prepared from the kernel with saffron.

(28) SPLINTS (*kambí*).—Made of (*pogiy*) the spathe of the blossom used for this purpose by the *toddy* drawers and natives of Goa, &c.

(29) DOOR MATS.—Made of the fibre of many shapes and sizes by natives and in the jails.

(30) BUGGY MATS.—Made of the fibre of many shapes and sizes by natives and in the jails.

(31) CARRIAGE MATS.—Made of the fibre of many shapes and sizes by natives and in the jails.

(32) FLOOR MATS.—Made in Malabar and in the Bombay, jails of different sorts and colours.

33] CAGE. (*Pinjará Khurí*).—Made of the rib of the leaf.

(34) HORN (*Pipáni Tontora*).—Made of the leaf of the palm; gives a loud sound when fresh.

(35) HORN SMALL SIZE (*Dhakti Pipáni*.).—Made of the leaf of the palm; gives a loud sound when fresh.

(36) TOY PARROT (*Popat*). Made by children of the leaf of the palm; when new it looks better.

(37) TOY PARROT IN CAGE (*Pinjaryát Popat*).—Made by children from the leaf of the palm; when new it looks better.

(38) LEAF WOVEN CURTAIN (*Zadi*). The leaf of the tree, used for thatching houses, has the advantage over tiles of keeping the house cool.

(39) ROOT (*Múl*).—Used medicinally, astringent, and as a gargle for sore mouth.

(40) ROPE (*Káth Sumbhá*).—This is extensively used.

(41) OIL-BOTTLE (*Dowlá*).—Hung beneath the labour-cart with castor oil and brush in it for lubricating axles.

(42) NUT, IMMATURE (*Khakota*).—Used medicinally as an astringent: children are fond of it.

(43) TROUGH (*Panshiva*).—Trough made of coconut tree, used for catching water drawn from a well with a Persian wheel for irrigation purposes (model).

(44) CONDUIT (*Panlál*). A conduit put under the hole of the trough for conveying water for irrigation purposes.

(45) ADAPTER (*Nalál*.—Piece of the adapter used for connecting the native still to the condenser.

(46) (*Tantuna*).—Native musical instrument, used by the poorer classes.

(47) BEAM (*Bálál*).—Piece of beam of the shape used for houses. It is also used for fishing-stakes in the sea; generally two coconut trees make a stake 60 to 70 feet long.

(48) ROSARY BOX.—Made of immature coconuts.

(49) CHARCOAL POWDER (*Kolsá*). Burnt shell used for preparing black and lead-coloured washes for houses.

(50) BROOM (*Zádú*) —Made of the ribs of the leaf; used by the Bombay and other municipalities for sweeping roads, streets, yards, &c.

(51) BROOM (*Zádáú*). Made of the stems of the blossom and nuts: used by the cultivators for collecting dry leaves for (*rab*) burning on the fields.

(52) CRAB TRAP (*Kathimbra Dhodará*).—Made of the stem of the leaf.

(53) FISH TRAP (*Muhui*).—Made of the ribs of the leaf.

(54) STRING OF POTS (*Mál*). This is made of fibre of 60 or 70 feet in length, and about 50 or 60 earthen pots fixed to it and put on the Persian wheel (*rahat*), which in rotating brings up the pots filled with water and takes down the empty ones.

(55) VIOLIN (*Sárangi*).—Used by the lower classes of natives, particularly the gosavies (a class of professional beggars).

(56) SLING (*Shinko*). Used for keeping sundry articles of food out of the reach of cats, rats, and ants by hanging it on a hook to the ceiling. Tied to the ends of a bamboo, serves for carrying water-pot baskets &c. The small one is used by milkmen for carrying milk for sale.

(57) FLESH GLOVE (*Hátáli*).– Used for washing and rubbing cattle and horses.

(58) TAR WITH ACETIC ACID (*Karleli*). Made by burning the shells in a pot with a small hole in the bottom, placed on another, heated by fire on all sides. Used by the natives for ringworm and skin diseases.

(59) ROPE (*Dore*).—Made of various sorts and sizes.

(60) BRUSH (*Chavár*).– Made of the husk of the nut for cleaning sieves, washing baskets and rice-drainers (*Shibum*).

(61) SUGAR MOLASSES (*Gul*).—Made of the juice (*toddy*) in Goa.

(62) (*Band*). Peeled from the outer part of the stem of the leaf. Is used as a cord by the *toddy* drawers.

(63) COCONUT GILDED (*Kanyácha Nárel*). Offered by the higher classes of Hindus to appease the sea on the coconut fair day. At weddings the bridegroom and bride carry it in their hands.

(64) HUSK (*Sál Chaváid Sodáu*). Used as fuel. Specially for backing purposes; also affords coir fibre.

(65) SCOOPS.–Made of the shell. The round and deep ones are used as drinking cups.

(66) NECK BELTS (*Pattá*).– Used for yoking bullocks and buffaloes to carts, ploughs, oil-mills, &c.

(67) SACK (*Thoili Jati*).—Used for sending out articles; a somewhat similar one is attached to the cart for carrying straw or grass.

(68) TOOTH-BRUSHES (*Díton*).—The pedicles of the blossom are used as tooth-brushes.

(69) BRUSHES (*Kunchá Kuchrá*).–The pedunecles of the blossom are used for whitewashing houses, &c.

(70) BLIND (*Dol-Dhdpau*).–Used for blinding bullocks and buffaloes while yoked to the Persian wheel, oil-mill, &c.

(71) NEST (*Gharta, Gharbá*). Made by birds out of the fibre of the leaf.

(72) SOAP (*Sabu*).– Made of coconut oil; has larger percentage of water than any other soap.

(73) PUZZLES AND TOYS. Rings, whips, necktics, rattles, crosses, &c.

(74) BATS FOR CRICKET. –Made of the wood (coconut).

(75) OIL-CAKES (*Pend*). Oil-cake from the native mill.

(76) PATIMAR (SHIP) (*Fátemari*).—Toy made by the boys of the fishermen class.

(77) BOAT, FISHING (*Hodke*). –Toy made by the boys of the fishermen class.

(78) KERNEL (*Khobre*).—Dry kernel.

(79) STEM (*Jhuntár*).—Used as broom.

(80) CHARPAI, CUT (*Khát, Báj*).–Used by the natives (model).

(81) POTASH (CRUDE) (*Khár*). The ash of the stem of the leaves; they Produce 20 per cent. of ash.

(82) COCONUT, ABORTIVE (*Vánzá Nárel, Válil*). Used as floats for beginners in swimming.

(83) SPADIX.—The spadix prepared for drawing juice (*toddy*). A thin slice is cut from the palm stem three times a day. The juice flows from this and drips down into an earthen pot suspended on purpose. A small piece of the leaf is fixed above to prevent the bottom of the pot from touching the point, the sheath of the leaf covering the mouth of the pot to keep out flies.

CODILLA. A commercial term for the refuse separated on cleaning hemp or flax fibres.

COCONUT CULTIVATION AND MANUFACTURE OF THE OIL IN SOUTHERN INDIA AND CEYLON:

WHY SHOULD COCHIN OIL SELL 36 PER CENT BETTER THAN CEYLON?

HOW TO IMPROVE THE CEYLON COPRA.

(From the *Ceylon Observer*, 30th October, 1897.)

A most practical question, and one that has been far too long neglected, is raised in the enquiry with which we head our remarks. Can there be any permanent unchangeable reason why "Cochin" coconut oil should fetch, on an average, 35 per cent. more value in the London market than the coconut oil from Ceylon? Cochin is three degrees farther from the equator than Colombo; but in most respects must have a climate and soil very similar to that of our West Coast, save that its dry season is said to be longer. Applying to a Colombo friend with prolonged experience for an explanation, we have been favoured with the following interesting remarks:—

"The superiority of Cochin coconut oil over Ceylon oil is due to the superior whiteness and quality generally of the Cochin copra as compared with Ceylon copra. Although the S.-W. monsoon rains from end of May to August are very heavy in the Cochin State, there is larger number of dry months than in Ceylon, and it is in these dry months that the coconut kernels are dried in the sun only, which gives a whiter and better copra than the average of Ceylon, and as Cochin oil is made from this whiter copra, this accounts for its superiority. It is not supposed that the Cochin coconuts are practically better than Ceylon nuts, but that the superiority of the Cochin oil may be attributed solely to the better climate, and to the superiority of the preparation of the copra from which the oil is made. Cochin oil is believed to contain a larger proportion of stearine than Ceylon oil, and hence its special suitableness for the manufacture of fine candles such as those made by Price's Patent Candle Company, which are so well and favourably known to the public."

We give the next an interesting communication,- which, in reality, prompted our enquiry —that reached us by a recent mail from a very old Colombo merchant long retired from the Island: we have filled in the figures of rainfall and temperature for our West Coast as desired by him. He writes as follows: -

"Has the question ever been raised and discussed wherefore there should exist such a material difference in the value in Europe between Ceylon coconut oil and the oil shipped from the Western Coast of India?* It is quite worth discussion. Though a difference in climate may account for part of the difference in value, there are methods in the cultivation of the nut and the preparation of copra which, if attended to in Ceylon, should increase the production of nuts and improve their quality and, therefore, the value of the oil. The climate of the West Coast of India differs greatly from that of Ceylon. The south-west monsoon beginning about the middle of May is generally one continuous downpour until about the first week in August; during which period mostly 100 inches of rain are measured, some 20 more inches falling during other parts of the year. In Ceylon

* Prices in London (6th October) Ceylon oil £22, Cochin oil £29 10s to £30.

the average fall in the lowcountry ranges from 90 inches at Galle, 88 at Colombo, 68 at Negombo to 51 at Chilaw. The temperature in Cochin ranges from 80 to 90 Fahr.; whilst on the sea coast in Ceylon the thermometer averages only about 79 at Galle and Puttalam and 80 degrees at Colombo. In both particulars there is therefore a considerable excess over Ceylon.

"The cultivation of the coconut palm for nut-production and copra-making, so far as these terms are applicable to Ceylon, is much influenced by the character of the natives of the two countries. The Sinhalese are not a painstaking people; the natives of South India are more intelligent and will take very much more trouble in all the work of their hands. No doubt the natives of both countries recognise the good old proverb, that 'the coconut tree likes to hear the people talk,' and the good effect of burning the dry fallen leaves underneath them to destroy injurious insects. The Indian 'prunes' his trees; that is, he cuts away the old stalks which have borne nuts. For cultivation a very simple process is practised, viz., breaking up the soil about the root generally into little heaps, into which are brought the ashes of burnt leaves, at the time when the immediate advent of the monsoon is apprehended. Both these simple processes increase the yield of nuts, so that in ordinary years there is a bunch of ripe fruit, often of 12 nuts, to be gathered every month.

"The making of copra is a careful operation in India; and far otherwise in Ceylon. The nuts when opened are not placed on the bare ground in the sun or exposed to a fire, but clean mats are put down to which the women attend, taking them in at night or covering them over on the approach of rain. The pressing of the oil by the checku is the same in both countries; but even in this part of the process the Indian is the superior in cleanly methods.

"These few hints are given for what they are worth. It is not supposed our native friends in Ceylon will change their methods; but European proprietors and superintendents of coconut plantations by accepting these recommendations may increase the produce of their trees and improve the quality and value of their oil. Sometimes a red tint is observable in the oil. This arises from too long delay between the gathering from the tree and the conversion of the kernel into copra by exposure to the sun; especially when the nuts in their husks are piled in heaps in the open air, germination having commenced within the shell. These should be carefully avoided, germinating nuts being discarded. What is desired is a clear colourless oil when finally pumped into the casks for shipment, to procure a white solid sample when offered for sale in London or at the Continental Ports."

We now return to the practical question with which we opened. Surely, we may say we have as good coconut palms in Ceylon as on the Cochin coast; as good soil and a climate equally favourable at least in the districts North of Colombo (and in Batticaloa and Jaffna?); and if this be granted what is to hinder equally good copra being prepared here? It seems to us that the explanation must be found in the greater care exercised by the natives of Cochin in their handling and drying of the copra—a fact that is testified to by both our mercantile correspondents, and that it should be quite possible, say in the Marawila and Chilaw districts, if not in the Negombo district—to prepare with a little extra care, copra equal to that of Cochin.

For instance, not only can Negombo, Marawila and Chilaw (including Rajakadalnwa) boast of most luxuriant palms growing in fine soil; but even Cochin can scarcely show a much larger number of dry sunny days during which copra might be prepared. We find that the meteorological

* We suppose there are European oil-preparing mills at Cochin as at Colombo? COMPILER.

record for the several centres of coconut cultivation in Ceylon runs as follows :

Name of Station.	Average annual total: Rainfall:	Rainy days:	Dry days:	Side of Ceylon.
Colombo	88·52	171	191	West
Henaratgoda	93·84	148	217	West-inland
Kalutara	89·03	151	214	South-West
Galle	91·47	206	159	South
Matara	68·26	99	266	South
Negombo	67·11	98	267	West
Chilaw (Horakelle)	65·45	92	273	North-West
,, (Rajakadalna)	54·50	106	259	North-West
Puttalam	56·38	78	287	North-West
Kalawewa	50·14	76	289	North-Central
Kurunegala	81·12	108	197	Central (low-country)
Jaffna	17·68	72	293	North
Batticaloa	51·85	104	261	East

From the above we would specially select the Negombo, Chilaw, Kurunegala, Jaffna and Batticaloa districts and ask, for what reason if sufficient manual care be taken as good and attractive copra cannot be prepared from the coconuts in each of these as in Cochin? We have heard, indeed, of plantation copra from Batticaloa being pronounced very superior to ordinary Ceylon. Is this an established fact? If there is no other remedy, would it not pay on some of our plantations to import some natives of Cochin accustomed to manipulate the coconut kernels for copra in that State?

We await the opinions or experiments of practical planters in the districts referred to, from whom we shall be glad to hear on the subject; for surely, if increased care in preparation increase the price of a great part of Ceylon oil even ten or twenty, much more by thirty-six, per cent., there is ample reward awaiting the experiment. One point may be raised as to the greater proportion of stearine in Cochin coconut oil; if this be due to soil, we should have to get samples from Cochin to analyse and compare with our Ceylon coconut soils*; but we cannot believe there can be much difference in this respect between the best of our West Coast and the Coast of Cochin. The difference is most likely to arise from the more careful cultivation of the palm, the plucking of ripe nuts only, and the watchful manipulation, as already described, of the kernels to secure the best copra. All this should be within the reach of coconut estate proprietors in Ceylon, at least in some of the districts we have selected as most allied to Cochin in climate and soil.

CEYLON *VS.* COCHIN COPRA.

On the subject of the above article we have drawn up the following questions and circulated them among authorities in Colombo who have not already given us their opinions:—

QUESTIONS:

The following are the questions embodied in our Circular:—

1. Have you ever considered the reasons for Cochin oil selling for 30 to 36 per cent more than Ceylon Coconut Oil?

2. What is your opinion after having read the article in *Ceylon Observer*, of 30th October?

3. Do you think it possible in your District to give the same attention to palms and kernels as is given by the Cochinese according to the description under notice?

* There is a valuable chapter of analyses for "Coconuts" (soils, nuts, oil, &c, n Cochran's "Ceylon Manual of Chemical Analyses."—COMPILER.

4. Any objections or difficulties in your district

5. In what Districts of Ceylon would you think the best results could be obtained?

6. Would you recommend a Ceylon Superintendent being sent to Cochin to note what is done there from beginning to end: the nature of the soil, cultivation of palm, etc.?

7. Or, would you recommend getting two or three Cochin natives accustomed in copra and oil-making to work on local plantations?

8. Do you know of any Ceylon estate or district whose copra or oil is always superior to ordinary Ceylon oil, and approximates to Cochin?

9 Any other observations?

The first set of answers to reach us, is from Messes. Volkart Brothers, and this firm with prolonged experience both here and in India, shew clearly that much more might be done with Ceylon copra:—

ANSWERS TO CIRCULAR.

No. I.

1. Yes: Cochin copra is never smoked or kiln dried, always sun-dried; hence the oil, that is pressed out of it, becomes whiter.

2. Our opinion is that if the same method in preparing and drying copra as at Cochin, were practised in Ceylon - Ceylon oil would equal Cochin oil or nearly so.

3. Certainly.

4. ——.

5. Jaffna and Batticaloa.

6. For merchants and mill owners it makes but little difference, whether ordinary or white oil is being shipped. It would certainly be to the interest of planters, to adopt Cochin methods and send people over to study these or employ Cochinese here.

7. We are the largest shippers of copra from Ceylon and employ Malabar people to superintend drying, etc.

8. Calpentyn, Jaffna and Batticaloa supply the best copra; Madampe the worst.

9. ——.

Per Pro. VOLKART BROTHERS.
A. BOHLMANN.

The following have been received from well-known planting authorities:—

No. II.

One reason for Cochin oil fetching more than Ceylon oil is that the process of manufacturing it is quite different in the former place from that of the latter. Cochin nuts are smaller than Ceylon nuts and the outturn of oil is roughly speaking about 2½ cwt. per candy for Cochin against 3 cwt. for Ceylon. The Coconut area in Cochin is small as compared with Ceylon, and more care is taken there in the plucking and the drying of the nuts. Only ripe nuts are plucked and the kernel is cut into slices, and carefully dried in the sun. All unripe and bad nuts are removed and only the good clean white copra is manufactured into oil. This is the white oil of Cochin and it is used in some parts of India as a substitute for ghee. Monsoon-made oil sometimes fetches the same price as white oil, if the quality is fine, but the objection to monsoon-made oil is, that it is, as a rule, off the color in consequence of the damp weather rendering the copra liable to get mouldy, but of course there may be some fine oil made during the monsoon. Greater care in the plucking and drying of the nuts may be bestowed in Ceylon, but the area is too wide, and the climate will not permit of the proper drying of the nuts in the sun. Nuts are plucked anyhow or nohow here, split into two and thrown to dry in the sun, and if the weather is bad, all the kernels are put on a platform and smoked, which blackens the copra and imparts to it a smoky taste. The copra is then hurried off to the

carts or boats to Colombo. Little or no trouble is taken to separate the good copra from the bad nor the white from the black. All come to the mills and it is this produces the Ceylon oil.

White oil, indeed, is manufactured in Colombo but the demand is limited and manufacturers do not keep a stock of it. It fetches about R20 per ton over ordinary good merchantable oil. A good deal of care is taken on some of the estates owned by a well-known Ceylon gentleman, and the copra from these properties always fetches quite R1 per candy over ordinary quality. The best result would be obtained in the Chilaw District. Copra is frequently brought into Colombo from Batticaloa. The climate being dry there the shells get hard soon. It is for this reason that the nut is broken the other way, from top to bottom, for, if the usual custom was followed, the shell would get "splintered" and damage the kernel.

There is but little use, in my opinion, of either sending a Ceylon Superintendent to Cochin to learn the method of manufacturing or in bringing over Cochinese to teach the way how to do the work in Ceylon, so long as our climate is what it is. The Cochin men may lead in anything, but they cannot control the clerk of the weather; we have rain almost throughout the year and the coconuts cannot be kept on the trees.* They must be plucked, and rain or no rain, the copra is made and quickly converted into cash! Some years ago a firm of mill-owners manufactured oil from selected copra brought from their own estates. This was superior to ordinary oil and always commanded in London about £1 per ton over the value of ordinary Ceylon, but this firm have now gone largely into the Desiccating line and have given up oilmaking. In this connection it must not be forgotten that copra from the Pacific South Sea Islands, Australia and other places is imported into Liverpool and this competes to a large extent with our oil. In the "sixties" and "seventies" during the existence of Armitage Brothers and C. Shand & Co., a very large business was done in Ceylon coconut oil, the contract being sometimes for thousands of tons at a time. The former firm who owned Mills at Mattacoolly and Mutwal were very large charterers of sailing vessels, and so of the largest ships that ever loaded here were chartered by them. The volume of business then was done direct with London, but now every thing is changed and the news telegraphed out that the stock of coconut oil was 200 tons, the month's landings 200 tons, and the deliveries 200 tons, points to what straits the business in coconut oil with London has come to in 1897 compared with what it was in 1860-70. C.

No. III.

1. Yes; and if you will look up the *Tropical Agriculturist* for 1895 or 1896 you will find that this question was discussed in the *Ceylon Observer* and opinions elicited.

2. My opinion is that the great difference is almost, if not entirely due to the large amount of stearine in the Cochin oil.

3. Quite. Although there is not the same long spell of dry weather: yet copra dried over coconut *shell* fires can be cured quite as white as sun dried.

4. None except the more frequent rains preventing copra being sun dried.

5. In Jaffna, Kalpitiya, Batticaloa, and Chilaw. I am quite sure that copra as fine as any Cochin article can be, and is prepared in these districts.

6. Perhaps it would be advisable. There *may* be something done there of which we are ignorant, though I doubt it!

7. No; by no means.

8. Answered in No. 5.

9. I am afraid that the difference is due to climate and soil and perhaps, to some extent, to keeping the nuts for so many months before converting them into copra. Is there no reliable person in Cochin from whom information might be got? W. J.

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* Our correspondent forgets our dry districts—some with 250 to nearly 293 dry days! COMPILER.

No. IV.

Oct. 5, 1897.

1. The difference in price of Cochin and Ceylon coconut oil attracted my attention many years ago. The experts in the trade whom I consulted, referred the difference, partly to Cochin oil being richer in stearine, partly to speculation and combination among owners.

2. My opinion, confirmed by the *Ceylon Observer* article of 30th October, is that a third explanation is to be found in the fact that most of our copra is smoke dried, much of it positively black, yielding oil which cannot be filtered white.

3. Not the same, perhaps, to kernel, because greater humidity of the air and the greater rainfall: but more attention than now. To palms the same attention can be paid as in the most favoured countries.

4. The special difficulty in the way of sun drying in this district is the absence of the sun for a good part of the year. Half the number of days in the year is wet or drizzly, and the sun is often obscured by clouds; but smoke drying is resorted to too readily,

5. In Jaffna, Batticaloa, Mannar, Kalpitiya, and Puttalam. If the copra from these districts should sell distinctly better, not only because it is better dried through its long journey but because it is sun-dried, other districts would resort to open air-drying whenever possible.

6. It would be an advantage, but it is not absolutely necessary. Cultivation is understood here and is being practised with with good results—larger crops and thicker kernels.

7. That, too, may be desirable, but is not essential. Copra drying is a simple process and every one knows that well dried copra is more valuable than damp, and clean is preferred to dirty. There should be an incentive to greater resort to the sun than to fire.

8. The copra of Jaffna, Batticaloa, Puttalam and Kalpitiya is generally superior to that of other districts because it is cleaner and better dried and it fetches better prices, because it contains less moisture. The oil of one district cannot be compared with that of another, as there are no district mills and district oils.

9. For the above reasons I do not agree that is merely a planters' question. If the mill-owner offers more for sun-dried copra than for smoke-dried, in order to prepare white oil as a speciality, there will be inducement for planters to avoid smoke or steam drying, except as a last resort.

F. B

No. V.

Nov. 1, 1897.

I have not had any practical experience in coconut oil manufacture—so cannot reply to question 1—7. As regards (8) I can only repeat what I heard from Mr. O'Grady of Karativoe estate, who told me he took home some of his (chekku-mill) oil and submitted it to some large dealers in London, who after examination assured him that it was far superior to ordinary Ceylon oil, and I think he said equal to Cochin; but that to secure a proper price it should come into the London market under some different designation than "Ceylon" oil.

On another occasion I know Mr O'Grady made some very superior Copra for a local Chetty, who sent it to Calcutta (to be used he said for sweetmeats), but it took a lot of trouble and additional expense and did not pay.

So these facts show it is in the long dry season which prevails on the Eastern side of the island that there could be prepared a superior class of copra and oil.

Mr. O'Grady would give fuller particulars doubtless if asked.

I may also mention that in the Batticaloa estates, the nuts are left (I think for a month) in the (coir) husk before being split which is done with an axe without removing the husk.

E. ELLIOTT.

No. VI.

1. For the reason that no endeavour is made in Ceylon to export white oil. I saw a sample of white oil in Colombo some time ago, which, if exported, should approximate, if not equal, Cochin oil.

2. Except as regards any superiority due to climate conditions, there is no reason why Ceylon oil should not be as good as Cochin.

3. The attention given to palms on my estate is quite equal to that in the description you notice. So the treatment of kernels too. I do not see any difference between our methods and those adopted in Cochin except as regards the use of mats.

4. I believe there is not so much uniform sunshine here as in Cochin, hence we are obliged to have more recourse to fire. In drying by fire there is now no means of excluding the smoke, which accounts for the bad colour. If the smoke could be excluded by the introduction of some kind of Sirocco, I think much of our difficulties may be overcome.

5. Kalpitiya, Puttalam, Rajakadaluwa and Chilaw should do well. I believe Jaffna and Batticaloa would also do, although I have no acquaintance with them.

6. & 7. I do not see any necessity of adopting either of the suggestions. Given good weather and good nuts there is no difficulty in making white copra.

8. No.

9. My experience is that nuts of estates on the sea-board make the best copra. I think this superiority is due to the presence of salt in the soil. If some means could be devised for obtaining salt at cheaper rates for manuring purposes and better methods of manuring are adopted, I think our nuts will not be much inferior to those in Cochin, and if some method can be devised of drying copra by means of a uniform heat without smoke, I think we will be able to manufacture a very superior oil in Ceylon.

D. J.

We direct attention to two thoroughly practical communications discussing this matter below. One is from the Manager of a large plantation in the Rajakadaluwa district beyond Chilaw, which ought to be specially favourable for sun drying and the other bears the initials of old contributor who will be recognised as almost "the Patriarch" among coconut planters, at any rate in the Western Province of Ceylon. The former supplies a great deal of out-of-the-way information as to the careless, if not fraudulent, way in which copra is treated by native owners and middlemen before reaching the mills; and both writers seem to make it evident that the Mill Managers are pretty well helpless in reference to reform—since they must take the copra as offered, and it would not be profitable for them to deal separately with small quantities of cleanly superior or sun-dried copra.

But "W.B.S." shows us very plainly how private estate owners in Ceylon, anxious to do as much justice to their nut-kernels as is done in Cochin, can accomplish their purpose. We infer from what he says that a "Sirocco" (or query "Dessiccator")—or even a more primitive contrivance described by our correspondent would enable copra to be properly dried even in our wetter districts; while in the dried series which must have as many sunny days as Cochin—the result can be arrived at with a little care more simply and economically. "W.B.S." tells us of a proprietor of 200 acres of coco-palms who regularly prepared his own copra and manufactured superior oil from it on the estate, we suppose at a considerable profit over his neighbours' return? With this example before them, we do not see why a good many individual planters should not go and do likewise and secure in the London market not £21 to £22 but £29 to £30 for their oil. "W.B.L." says it should pay to erect a Mill (with hydraulic presses) for 50 acres; but to make the venture safer a Syndicate of proprietors owning not less than 1,000 acres or why not a Limited Company buying up estates to that extent?—should be tried to establish a Mill to manufacture only superior Ceylon oil. No doubt, a distinctive mark would have to be adopted to secure due attention in the London market. With a margin of from 30 to 36 per cent. to go on, it does not seem to us that encouragement is wanting to deal with an enterprise of this kind.

No VII.—(*Insert to Circular by a Rajakadaluwa Manager.*)

Nov 6, 1897.

I have read the leader of *Ceylon Observer* of 30th ultimo with great interest. The superiority of the Cochin coconut oil, as evidenced by the high price it obtains in the London market, is a matter well worthy of our consideration and the remarks made in the leader are quite to the point. The opinions expressed on the subject by the authorities quoted are perfectly correct so that little remains to be added. Considering what large tracts of land in Ceylon are under coconut cultivation and what vast quantities of copra are prepared, it behoves us to put our best foot forward and see if we cannot successfully compete with our rival, but what is the use of the energy and care of a few when the vast majority of the natives in this island engaged in the coconut industry are notorious for their apathy.

To make good copra, as made in Cochin, three things are of paramount importance—*1st, the choice nuts; 2nd, mode of manipulation; 3rd, time of drying.*

1. With regard to the choice of nuts—these should be thoroughly well matured and dry *on the tree* before plucking and of a dark-brown colour. Nuts that are so dry that they save their connection with the parent tree by their own weight and fall of themselves are the best adapted for making copra. The Cochin nuts are so gathered and I suspect this accounts for the larger percentage of stearine in the Cochin oil. By this are the two bunches of thoroughly matured nuts may be relied upon from a well-bearing tree and the third or less matured bunch may be left to form the first bunch of the next crop and so on. These nuts should be plucked once in three months instead of two months so as to ensure two perfectly dried branches. The nuts when plucked should not be left in a heap longer than three weeks or a month by which time the kernel is so far desiccated that it comes away from the shell after a slight exposure to the sun and very often the moment the nut is split. Germinated nuts should be avoided if a first-class copra is to be turned out. The general rule of Ceylon is to pluck once every two months. I think this accounts for the inferiority of our copra, for unmature nuts are bound to be mixed with the mature ones even on the best regulated plantations.

2. As regards the manipulation, nuts should be placed in a fierce sun as soon as they are split, care being taken that no sand or earthy matter adheres to inner surface. Where practicable they should be placed on mats and cadjans till the surface moisture sufficiently evaporates, leaving a dry inner surface to which foreign substances cannot cling. This can be ascertained by passing one's fingers over the inner surface a few hours after the nuts are exposed. When this amount of dryage is ascertained and the kernels are detached from the shells, mats and cadjans are no longer needed, and the kernels may then be placed on the bare sand (the looser and whiter the sand the better) till thoroughly dried, without any fear of taint. Where large quantities of copra are prepared at a time it is not always feasible to effect the preliminary drying on mats and cadjans, but it is trouble well laid out when the ulterior benefit is taken into account.

In Ceylon the natives are very careless as to what becomes of the nuts in the splitting. They are split and chucked about anyhow, rolling over muddy ground or dirty sandy soil clogged and damp with coconut water or over patches of cattle dung or any dirt that is lying unswept. The nuts are then spread out to dry with a large percentage of earth sticking to them, thus rudely spoiling their snow-white appearance. The earthy matter leaves its stain and quantities of sand are embedded in the body of the kernel. This is regarded by the natives as the proper thing to happen as it increases the weight of the copra. I have seen sand actually thrown on the newly-split nuts for this very purpose. How is it possible to obtain a good merchantable copra when men are capable of such nefarious practices? In some instances the coconut water is not all out of the split kernels when exposed to the sun, a small portion at the bottom is allowed to remain and evaporate slowly (as it is too much trouble to throw it out) and in this slow process of evaporation a sticky gummy substance is formed which cling to the bottom of the kernel and readily holds any rubbish that may eventually come into contact with it.

The kernels should be placed closely side by side to dry, but no nuts should be split after 11 a.m., as those split in the morning get the benefit of a full day's sun, whereas those split in the afternoon may, or may not, get a dry inner surface by the evening. This is an important factor in the drying process, for damp on the inner surface all night long is apt to engender a sticky substance which may induce mildew before the sun rises next day and present a sorry appearance in juxtaposition with the better dried kernels,

The kernels should be placed in long narrow heaps about 8 inches deep and covered with cadjans before nightfall so as to prevent the dew getting on them, as any watery interference with the oleaginous surface is most detrimental to the unique colour of the copra. These heaps should next day be spread out again in the sun, as at first, and so on till perfectly dry.

Kernels dried on sandy soil dry quicker than those on ordinary hard ground, as the heat of the sand at the bottom is intenser than that of common earth, and helps to dry the kernel faster. A white colour is produced by hard bleaching.

When the kernels are well dried (which can be ascertained by a sharp snapping sound they make when doubled and pressed in the fist and by an even leaden hue perceptible in the broken portion where the escaping oil stains the outer surface) they should not be allowed to sweat too long in heaps. The sooner they are despatched to the mill the better for the oil they are expected to yield. Mildew forms thickly and rapidly and is most prejudicial to the making of a colourless oil; but with a nice, even, snow white inner surface and a thoroughly sun-dried kernel, I don't see why the good colourless oil should not be made in Ceylon equal to that of Cochin, provided no other copra of inferior quality is mixed with the good lot crushed. The heterogeneous mixing of all kinds of copra in the mills is a great evil. If good, bad and indifferent are all crushed together it is impossible to get any other than the amber-coloured oil now in vogue, which, when congealed, gives a palish yellow hue instead of alabaster white. The excess of stearine in Cochin oil, which makes it preferable for candle-making purposes, is, I suspect, due to the excellence of the nut and not to the superiority of soil—an excellence attained by full maturity and a regular system of manuring the trees—for the soil of the west and north-west coast of Ceylon compares favourably with any soil in the world as a feeding ground for the coconut palm.

3. As regards the time when copra should be made I am convinced that the hottest and driest season of the year before the advent of the south-west monsoon (*i.e.* between January and June) is the best, because it is the most reliable for heat and rainless days. Copra, to be white, should have no interruption in the process of dryage, save that of the night. It should run no risk—no heat but sun heat being used. If it has to be transferred from the drying ground to be finished off over the "Atuwa" fire in the event of clouds or rain intervening, then good-bye to the hope of making a pure white copra. The smoke of the coconut shell fire soon leaves its tell-tale mark on the inner surface and a browned, if not partially blackened, copra is the result. If the heat brought to bear on the kernels is not unique and continuous, a brownish tint is observable on the borders and this tint is bound to tarnish the oil expressed therefrom. Should rain-drops find their way to the copra whilst drying, a spotted and motley appearance ensues and these spots of many colours, in the development of mildew, can never be removed, no matter how severely they may be subsequently dried. Undoubtedly the colour of the oil is affected by these accidents. Rain and dew are the enemies of copra and should be carefully guarded against.

In Ceylon copra is made all the year round and plays at hide and seek with all weathers and consequently much damage accrues; but given a good season of the year, a well matured nut, thorough cleanliness of manipulation in a powerful sun and careful handling in the mill, and it would be hard lines indeed if we could not compete with Cochin. Good white copra has been turned out from heating-rooms, so well constructed as to be impervious to smoke and maintaining an equable temperature regulated by a thermometer. The heating room, if in good order, makes one independent of the weather, and if it involve no risk, should be resorted to by all proprietors of estates who turn their nuts into copra.

No. VIII.—(*Answer by an Old Coconut Planter.*)

Nov. 8, 1897.

Few parts of the coconut districts of Ceylon enjoy sufficient sunshine at all seasons to dry copra without more or less damage. These unfavourable climatic conditions are not the only cause of injury to this product, as it is usual to sell the nuts on the spot, to middlemen, who make a trade of it, and probably, three fourths of the crops of the Island pass through their hands. It is, of course their business to make as much profit as possible on their transactions, and as a large proportion of the original weight is moisture, it is an object to get it to market, with the greater part of the moisture retained. It is therefore put into a rude kiln after a few hours in the sun, not to dry, but to be smoked which prevents mould and rot from setting in at once. Thus most of the copra brought to market is discoloured with smoke, and contains at least 50 per cent of its original moisture. The large buyers therefore regulate the price according to the average quality, the only distinction being boat and cart copra. This seems rather a curious method of arranging prices, but there is some reason in it; boat copra comes chiefly from the dry climate, to the north of the Mahoya, where the drying process is less liable to be interrupted by rain, and if only half dry, when put into the boat, the drying goes on during the voyage of ten days or a fortnight, and it is perfectly dry when it arrives in Colombo. On the other hand, the cart copra is collected from the country round Colombo, within a distance of say thirty miles, and consists of the smoked article of the traders, and the still more carelessly prepared produce of the villagers. I do not know whether any change has taken place since I was familiar with the working of the oil mills, but then all copra that came in, was thrown in one heap, and taken to the stores as it came to hand. This produced a dark-coloured article which is still—I believe—the character of all Ceylon oil, and so it must continue so long as the bulk of the copra comes through the trader and the villager.

Perfectly ripe nuts, cleanly and thoroughly dried, consists of 66 per cent oil, and of poonac 34 per cent. The chekku cannot extract more than 60 to 63 per cent of oil, but the grinding stones and hydraulic press can do more with the same material; but with the common quality of the copra delivered at the mills the yield must be much less. Perfectly clean and dry copra yields an oil, that in a glass, beside another of spring water, the eye cannot distinguish a difference. Whether Cochin oil is *intrinsically superior* to the produce of Ceylon is a question for the chemist to decide; but there can be no doubt that clean colourless oil, would command a higher price in the markets of Europe and America than the smoke-stained article now supplied. There is not however the least hope, that the trader and the villager will spontaneously improve their methods, and the mill owners *probably* make *more profit* on the existing system than they would do by a superior article.

The only hope of raising the quality of Ceylon oil lies with the Europeans who are going in for coconut cultivation, which they may do, by rendering themselves independent of the nut dealer and the mill-owner. It has been done before, and can be done again on the same or improved lines. A coconut estate planted in 1840 about 200 acres, owned by a non-resident European, manufactured all its copra on the spot, for over twenty years with very satisfactory results. This was done by chekkus; but a property of 500 acres could afford to have its own mill, or several neighbouring properties might join in if convenient; at all events in a coconut district, nuts to keep the mill going could always be purchased at current rates. Every coconut estate should have an apparatus for artificial drying. Without that, no one can prevent copra, all the year round from getting mouldy and spotted. A sirocco would do first-rate; but there are cheaper means of attaining the end in view; anything will do that carries the heat without the smoke, say a sheet iron platform, with a fire of dry coconut husk, five feet lower, giving out heat without flame, and raising the temperature of the chamber above to 150 deg. which if kept up for 48 hours, will thoroughly dry the copra, and so clean and bright, that the oil made from it will be perfectly colourless.

Once on a time, the Engineer of one of the Colombo oil mills showed me a phial of clean bright oil, which I duly admired, and asked by what process he had got it. He replied that was his secret. "Do you propose to take out a patent"? "I'll consider of it" he said. "Well, I think you had best not go to that expense, for I could show you tons, as pure as that, and any one is free to inspect the process; it merely amounts to this:—"clean copra makes clean oil."

Ceylon may not be able to compete with Cochin in quality; but it is in her power to make the best of the material she has to deal with, and thereby gain both credit and profit.

W. B. L.

We append some half-a-dozen additional answers to our circular questions on this subject, so closing the discussion for the present. We trust some practical good will come out of it. We may say that the whole of the correspondence and remarks will be embodied in our forthcoming Coconut Planter's Manual. There can be little doubt, we think, that as regards both copra and oil from our drier districts—Jaffna, Batticaloa, Kalpitiya and Chilaw—only, as Mr. S. C. Munro hints, "a bad name"—a confounding of the superior with the general character of "Ceylon" copra and oil—can account for the value being placed lower than for Cochin. If that be the case, it rests with proprietors themselves, we think, to get matters put on a proper footing. Let them obtain standard samples of Cochin oil and copra from their Agents and then challenge comparison when they feel, in the drier district, especially, that they have attained to the same standard. At the same time, experiments in the directions pointed out by "J.D.V." and other correspondents could not fail to yield interesting and perhaps, profitable, results. "W"'s idea of using a "Clerihew" for drying copra in the wet season is a very good one, and we hope to hear of success.

No IX.

AN OFFER OF WHITE COPRA TO COLOMBO.

Nov. 7, 1897.

1. Yes. The reasons given in the issue of the *Ceylon Observer* of the 30th ultimo: are to the point. We of Pallai turn out much better copra than estates in the South, but nearly all our copra used to be shipped to Cochin! At present there are no purchasers here for the Indian market. In consequence price of copra has fallen, and we have to sell to the oilmongers.

2. I think it quite possible to make good clean copra rivalling that of Cochin, and indeed our copra is perfectly clean and white. I don't think there is much room for improvement over the Cochin treatment either of soil or kernel, though we don't use mats on which to spread the copra.

3. Matting would be excellent, but expensive. We heap the copra on the approach of rain and cover with *kudil* made of palmyrah olas and jungle sticks.

4. The only disadvantage is this: copra, if not sufficiently dry, is apt to get soiled and discoloured by heaping. Perhaps tarpaulin would be better to cover with, *without* heaping the copra.

5. Best results can only be obtained in the districts where the rainfall is lowest like Pallai: 10 in average per annum. In the South where the copra is fired, it is sure to be discoloured, and the oil expressed from it to be anything but limpid.

6. I am not quite sure if a Ceylon man could profit much by going to Cochin. I think it had better be left to individual effort.

7. However I won't speak dogmatically on the subject. But I certainly should prefer the course suggested in (6) rather than get Cochin men over.

8. I think it is quite clear from what I have already stated that Pallai copra is just as good as the Cochin copra. The oil here is perfectly clear.

9. I was about to write to you when this paper came to hand. *in re* the quality of the nuts.

There cannot be any material difference between these and the nuts of the Western or Southern Provinces, or even those of the Cochin Coast—at least so far as they contribute towards the clearness of the oil. The so called "superiority' of the copra is simply the *whiteness* of the copra which is entirely due to careful preparation and fine weather. We have from 8 to 10 months of dry weather, which people in the South don't have. Hence our copra is white and better in every respect. We spread out the nuts when split open on fine white hot sand, and the copra is hereby subjected to heat both on *top* and *underneath*. Thus the kernel comes out quite crisp and dry and perfectly white from the shell. It is only when we are disturbed by rain unexpectedly that the copra suffers and is apt to get discoloured and mouldy. It also gets soiled by being thrown about during heaping and then spreading out when the sun shines. The one problem that has been simmering in my head for the last 11 years since I settled here, is, how best to cover the copra *without* heaping it on the approach of rain. Tarpaulin might answer, but I have never tried it: and I am not sure if it is without disadvantages. My second question is what do *we* gain here in the North by our copra being whiter, seeing that we do not get a higher price for it than people in the South.

Supposing we take more than ordinary care with our copra and make it extra white and clean, what are the chances of getting higher prices, and what should be done to secure that end? There being no demand for copra in Cochin, local merchants do not buy copra now. Our price is regulated entirely by the prices ruling in the Colombo market. It is as a rule R4 less per candy at Jaffna than the Colombo price, with its inferior copra. If, indeed, the Colombo Oil Manufacturers offer us sufficient inducement, I, for my part, can guarantee to supply good, clean, white copra, quite equal to the Cochin copra in all respects.

One disadvantage of spreading out the broken nuts on *mats* instead of on hot sand is that it does not get the benefit of the hot sand, and I venture to think that spreading on mats is not a very great advantage any way. I don't think the copra would be any cleaner by the precaution.

I dare say that in Kalpitiya and Puttalam they should be able to turn out just as good copra as here. Good well-matured nuts, (specially dropped nuts) *sun-dried*, without being exposed to rain, will make excellent copra. I don't think you have the climatic conditions necessary for the preparation of copra of superior quality, either in the Western or in the Southern Province.

JOHN F. PHILIPS.

No. X

In answer to your circular on the above subject, the disparity between the prices for Ceylon and Cochin oil attracted my attention long ago, and I discussed the subject in the pages of a contemporary about dozen years ago It was then said that the reason was in the Cochin oil being richer in stearine than Ceylon oil. Coconuts in Cochin were said to be stored on covered *messas* or platforms, under which small fires were lighted, till the nuts were quite dry and had absorbed all the water or milk in them. They were then converted into copra. Of course this method of dealing with coconuts can be practised only by small peasant proprietors and is not possible on large estates which have to deal with hundreds of thousands of nuts at each picking, and when two crops are on the ground at the same time.

I think the proprietors of the large oil mills in Colombo will be able to inform you whether Cochin oil is richer in stearine than Ceylon, and how the white oil they turn out compares with Cochin as regards prices.

The communication of the retired Colombo merchant is very interesting and instructive. What he says about the application of ashes to the coconut tree only supports Mr. Cochran's recent analysis, that Potash is the leading mineral constituent of the coconut palm. Potash manures ought to be the principal manure for coconut trees, especially in sandy soils which are poor in potash, but not I think the only manure. It is gratifying to know that I am practising the style of cultivation which he says is practised successfully in Cochin, *i.e.*, turning up the soil round the trees and leaving it in little clods. The advantages of thus aerating the soil are too apparent to need explanation. I always dig in manure round the trees, and do not apply it in circular trenche, and I leave the clods of earth as they are. Further to prevent them from being battered down by the rain and caked by the sun, I use a mulch of coconut leaves and weeds. The loosened soil is then kept free and open for a considerable period. This is especially important in heavy soils which cake as hard as cement in dry weather. A friend, who followed my advice on a heavy soil, was full of the increased freeness and porosity of the soil which resulted from this treatment.

What your merchant friend says of the color of copra from germinated nuts is true. Desiccating mills will not use these as the stuff turned out is quite yellow. Copra likewise from these is quite discoloured and if dried over fires turns out black. Of course it is not possible for large estates to dry nuts on mats, but barbacues are possible and should, I think, be made on every estate making copra. The disadvantages of keeping nuts to be cured till dry weather sets in, are that left out as they of necessity are in the open, the bottom layer of nuts go bad or germinate even when the nuts are well spread out.

2. There is the delay in realising their value. I think that with a little attention means could be devised to dry coconuts white over fires. That this has not been done yet is, I think a reproach to all coconut planters. I know of experiments that have been made, but have been unsuccessful owing to sufficient thought not having been bestowed on them. Fire or smoke should not be allowed to come into contact with the nuts, especially in the earlier

stages when they are not quite dry as they then get readily discolored. I think a simple plan would be to have sheet iron immediately under the platform of "waratchies" on which the nuts are placed.

Unfortunately everything on a coconut estate is done on the "cheap Jack" system. On coffee and tea estates expensive stores were and are built, and much money spent on up-to-date machinery. Not so on coconut estates. Everything is of the most primitive kind, and "cheap and nasty" is the rule.

3 and 4. Quite possible to give the same attention in this district and elsewhere to copra curing and cultivation as in Cochin, but since I came here we have had very little continuously dry weather. If after coconuts are split they have not two days *at least* of the dry weather the copra gets mildewed. But after this, fire drying does not discolor the stuff.

5. Puttalam, Kalpitiya, Jaffna, Batticaloa and last Chilaw.

6 and 7. Hardly necessary. Copra curing is well-known here and we can dry white given the weather and failing the proper appliances, *i.e.*, a well-fitted hot room.

8. Kalpitiya copra always ranks first in the Colombo market and Marawila second. I do not know whether Jaffna and Batticaloa copra fills a large place in the Colombo market, but if it does there is no reason why it should not be classed with Kalpitiya.

9. Answered fully in the beginning of this paper.

I do not think it advisable for copra to be in direct contact with the fire, heated iron sheets. If a "messa" of "waratchies" will not live over the heated iron, won't perforated iron do? B.

No. XI.

1. Yes, but could not fathom it, as some years ago, (I believe even now) all copra from Jaffna was shipped to Cochin and the oil extracted there.

2. My opinion is, that it is not so much the copra that is to blame, but the mode of extracting the oil.

3. Yes.

4. No. Considering it to be the driest district in the island more or less.

5. Jaffna and Batticaloa.

6. Certainly. A good idea.

7. Certainly, I should also recommend getting some Cochin natives.

8. No.

9. I do not think the tint observed in the oil has anything to do with delay in collecting and making into copra, and nuts should always be allowed to lie in husks for at least a fortnight or three weeks. T.

No. XII.

November 11th, 1897.

1. Yes and in my opinion.

2. The vast difference between the price of Cochin oil and Ceylon is due principally to the better quality of copra the Cochin country is turning out.

3. I do not see why in dry districts the palm should not enjoy the same attention as it does in Cochin, and so with the kernels, if not all the year through at least most part of it.

4. My district is one of the wettest and in such localities unless expensive factories are provided, with rooms heated by steam and free of smoke, the quality of the copra must be inferior to that of the dry district. It is unquestionable, though, that with care and cleanliness our present means should be sufficient to secure a quality of copra nearly as good as that now produced by our dry districts, and these in their turn go much nearer to Cochin. The colour of copra does not depend solely on the means of heat (sun or fire), but a great deal on the handling while curing. In wet districts it is in fact a matter of repeated handling and shifting from the drying ground to the drying tray, layer upon layer, and from this again to the ground. It is during this handling that the fibre dust of the shells, and other dirt sticking to the gummy kernel spoil the appearance of the copra. This could only be avoided by having commodious hot rooms with plenty of trays where only one layer of kernels should be spread, but as long as our copra must be heaped up on a single drying tray eight to ten layers, one over the other, it will never turn out clean.

5. This is not the case in dry districts, where the split nuts once spread out on a mat to dry, and simply covered at nights, can be left there until ready. Those districts certainly should be able to give better copra than what they give at present.

6 and 7. Systematical, clean sun drying, or improved accommodation for artificial drying, and well matured nuts are, in my opinion, all that is wanted; hence not much to learn in Cochin, by a superintendent from a Cochin man here.

8. No, but I know of one estate in a wet district (with 128 inches up to 31st October) obtaining for its copra as good a price as Maravilla.

A NEW HAND.

No. XIII.

1. I have.
2. The principal cause is a bad name as regards the oil of this district, Batticaloa.
3. It is always done.
4. None.
5. Batticaloa, Jaffna and Kalpitiya.
6. I would not.
7. No.
8. Batticaloa, Jaffna.
9. In Buenos Ayres foreign wool growers can never obtain Australian prices from the bad name due only to the filthy condition of native wool.

S. C. MUNRO.

No. XIV.

1 and 2. Dr. Watt in his Dictionary of the Economic Products of India says that to produce fibre of the purest hue the green or unripe coconuts, *i.e.*, about ten months old, are used in South India,* and it may be that in this fact we have the explanation of the superiority of so-called "Cochin oil," with reference to which, too, Dr. Watt says that "he is almost forced to the opinion that by 'Cochin oil,' as with 'Cochin coir,' may be meant the superior qualities of the oil derived from the Madras Presidency." Several gentlemen connected with the coconut industry of South India have told me that nuts are not allowed there to thoroughly mature before they are plucked, as the fibre of the immature nut is so much superior to that of the mature, and the oil, though less in quantity, is superior in quality. Another difference from Ceylon practice pointed out to me was, that the nuts are not allowed to wither as with us for two to four weeks (and sometimes even as many months waiting for better markets) before they are husked, but are husked with a day or two of their being plucked for the sake of the fibre from the green husk and presumably the kernels are dried at the same time as well. Ceylon experience in the preparation of cooking oil and hair oil also shows that a superior white oil is obtained from the immature or rather partly mature nut. Our cooks, too, prefer such nuts in the preparation of curries. A careful series of analyses of samples of best and monsoon Cochin and of Ceylon oils extracted from nuts at various degrees of maturity and withering is very desirable.

3 and 4. The Ceylon growers and dealers would be only too glad to pluck their nuts earlier and dry them sooner, if it be the fact that less maturing on the trees and withering in the heap, would pay them better. But as for more careful preparation of copra than in the practice now, I do not think that is likely.

5. In the drier districts, that is where the air is least humid, Jaffna, Kalpitiya, Puttalam, portions of the Kurunegala district and Batticaloa.

6. Yes. Will W. J. oblige? His long experience, open mind and clear judgment would be invaluable in such an investigation.

7. We have a large number of Cochinese working our chekku and at our oil mills, and I suppose they are also to be found in our large gardens.

8. Answered in 5.

9. I shall test on a few acres the value of "pruning" off the stalks that have borne fruit. Does the sap continue to nourish these stalks? If so, the advice to prune seems sound; but would the bleeding of the sap not attract the red beetle?

J. D V.-d-S.

No. XV.

1. Ceylon can produce as good oil as Cochin. The fault is that the men do not pick the nuts when mature. Natives as a rule send small quantities to the market, and the market people make copra from all sorts of nuts

* Nuts mature with us when about 12 months old.

are discoloured by their method of drying and smoking them. I m f
m that we should dry our copra in a Clerihew's patent, similar to that
for coffee and the husk and shell could be used as fuel. Mr. Levy of
Bros. & Co. told me that they kept the coconuts on a shelf above a
ace for two months and this caused the oil to be clear and good. I have
one oil extracted from desiccated coconuts which was as clear as water.
n by and by to have a Clerihew's patent and to dry my copra by hot air.

We must dry our coconuts in the sun or by steam.

Certainly. I for one will not.

No. Where there is a will there is a way.

If we dry our coconuts by hot air and carefully pluck, I believe all
stricts in the island will produce good results. In Jaffna, Batticaloa,
hese places the copra is better simply because it receives more attention
n the other places.

I do not believe there is anything to be learned.

No.

No.

I am fully convinced that if our coconuts are dried by sun the oil will
ry bit as good as that of Cochin. W.

MANUFACTURE OF WHITE COCONUT OIL.

Colombo, Nov. 11, 1897.

EAR SIR,—In connection with the discussion now going on in your
it may interest you to hear that we have been manufacturing white
at oil regularly for the last ten years.—Yours faithfully,

FREUDENBERG & Co.

We are interested to learn that this description of oil has been
rly manufactured at the Hultsdorp Mills during the past decade.
uestion then is,—how does its value compare with "Cochin Oil,"
whether it is sold in Europe under a mark which distinguishes it
Ceylon oil generally. COMPILER.]

COCHIN VS. CEYLON COCONUT OIL.

OIL MILLS AT BATTICALOA.

BATTICALOA, 15th November, 1897.

R,—I have read the leader and correspondence in the *Observer* of the
st.—Cochin *vs.* Ceylon oil—with great interest.

might perhaps interest you to know that large quantities of our
un-dried copra are bought up by middlemen and shipped by native
s to Cochin, to be made into "Cochin" oil. This refers mostly to copra
by European planters, who take greater pains to produce good, clean
than the villager does. I know also that a considerable amount of
is shipped from Jaffna to Cochin. The mill owners in Ceylon would
ut an oil, which would be quite as good as Cochin oil, if they would
from making good clean copra with inferior stuff. On the estates
in charge of, every bit of discoloured copra is carefully picked out
old separately. Mill-owners, however, don't seem to care to pay a
price for superior copra, and therefore most estate proprietors
rouble much above the making of good clean copra. Mr. Le Mesurier,
glad to say, is putting up an oil mill here, and I also hear that a
r establishment is likely to be started by another European. But
k there will be no room for two mills, as even a small mill will
ne at least 50 cwt. of copra per day.—Yours faithfully, C. L

JAFFNA, 16th November, 1897.

R,—You complained some time ago in your paper that the cause of
reat difference in value of the Cochin coconut oil over the Ceylon
is due to the superior whiteness of the Cochin copra, which in
n, is owing to the fact that, at Cochin, the copra is dried more
ly than in Ceylon. It may interest some of your readers—merchants
ticular that, in the Jaffna district, owing to the dryness of the
, copra is dried by exposure to the sun, as soon as the nuts are
l, and it is, I believe, equal in quality to the best Cochin article.
made of it ought, therefore, to obtain as good a price.—Yours truly,

B. L. MARTYN.

COCONUT CULTIVATION.

HINTS TO THOSE ABOUT TO OPEN LAND UNDER COCONUTS.

Suitable land for coconuts having been purchased, it would, in my opinion, be very unwise to commit the common error of clearing it at once. One's first care should be the selection of nuts from well-grown, healthy trees whose branches do not droop or show a tendency to fall-off prematurely; the nuts should be large and heavy with a full kernel. So strongly am I of opinion that a careful choice of nuts is most essential, that I would recommend paying R10 or 15 more per 1,000 than the rates ruling in the districts where you buy, for the privilege of being allowed a free hand in their selection. On deciding what nuts will suit you, send your men once a month to pick one bunch from each of the selected trees; and when picking, each bunch must be lowered to the ground by means of a rope, or the nuts picked separately and dropped down one by one carefully.

When you have the requisite number of nuts for the acreage you intend opening, prepare your nurseries; the soil should be turned over well and burnt before levelling. Set the nuts close to each other, and in a slanting position; shade them from the sun, and water during dry weather. The nuts will germinate within four months from date of putting down, and if at the end of five months there are any which show no signs of growth, reject them, for they will never make healthy trees. When the seedlings are from 2 to 2½ inches high transplant them at intervals of 18 to 20 inches in another nursery, where they would have more sun; ashes applied lightly after transplanting will help the growth of the plants greatly. The plants when twelve months old will be big enough to put out into your clearing, and sufficiently strong to withstand the attacks of white ants, one of the most formidable of enemies of the young coconut plant. On removing the plants from the nursery, carrying them by their branches must be strictly forbidden, as want of care in this respect is very likely to result in injury to the "cabbage." May being a wet month is the best time of the year for planting.

In getting your land ready do not stint money on holing, the holes should be cut 3 feet square and 3 feet deep and lined 26 × 26; burn as much wood and rubbish, as you can get, in the holes and fill in with surface soil till they are 18" deep when you should put down your plants, after trimming the roots carefully, and press the earth down firmly round the nut. In undulating land terracing is very desirable, while all ant-hills should be levelled to the ground and the earth from them applied to the adjacent coconut trees. There are 65 plants to the acre, but in your nursery it will be as well to allow an average of 80, so as to provide for supplying vacancies caused by drought, white ants, beetles, lightning &c.

After planting give out your land on contract to native cultivators (goyiyas) for three years for the purpose of raising potatoes, cassava, &c.; in return for your granting them this privilege they must keep the coconut holes free from weeds and grass, and if they fail to do this they must submit to the forfeiture of one-half of the crops they raise. The goyiya must also undertake to report the destruction of any plant so that the vacancy may be filled immediately after the first rains. No vacancies should be allowed to remain unsupplied, as a property is greatly lowered in value by the presence of gaps.

As I have said the ills a coconut property is heir to are:—drought, white ants, beetles and lightning.

Of *beetles* the worst is the red kind (Sinh. Kandapanuwa). Any tree attacked by this fearful pest must at once be rooted out, chopped into pieces and burnt without allowing any of the insects to escape, the remedy here is very drastic, but there is no other, and if the one I advise is not adopted the result will be the scattering broadcast of a perfect army of destroyers to ravage not only your own, but your neighbours' estates. I have myself made it a point to find out and burn trees attacked by *Kandapanuwa* anywhere within two miles of my property; when a case is brought to my notice I send my own coolies to the spot to cut down and burn the tree, and as compensation for saving my neighbour further loss I make him a present of 50 cts!

When a tree has been partially struck by *lightning*, steps should at once be taken to bleed it and the surrounding trees by boring holes at their bases with an auger, by which means a large percentage can be saved. Any tree, however, that has been irretrievably struck by lightning should at once be cut down and burnt to prevent the breeding of Kandapanuwa within it.

Drought.—I do not water any plants when they are once put out in e field; they should be planted during the May rains. I only water em when they are in the nursery and the plants are generally one year l where they are put out.

Again, I lose very few plants by *white ants*; there are sometimes places here they destroy them often, and in such places I put in 2 years' old nuts. Be careful in such holes not to allow any grass or weeds to be it in when filling them up.

I may mention that there are about 30 different kinds of coconuts and do not as a rule prefer to get nuts for the nursery from any one district, have seen very good nuts got from Veyangoda, Negombo, Mirigama, d Colombo. get them from selected trees, not younger than 20 years' old, the nuts be arge and heavy, as I said before, with a full kernel.

In reply to the question as to the average yield of a coconut tree I may ention that during my experience I have seen trees which have borne) to 150 nuts each per annum; the yield of course depends on the nature the soil, the locality and the manner of cultivation. I have recently visited estate of about 150 acres in the Chilaw district, which I valued at R1,000 r acre, and I was told by the owner, who has refused an offer of R1,200 per re, that he gets over 100 nuts per annum on an average from each tree.

Land cleared and planted by me in May 1887 is now in partial bearing, 200 ees have borne a crop, from which copra was made and sold.—W. H. W.

Kandangomuwa, Mirigama, May 1891.

"COCO-NUT OR COCOA-NUT."

("*Ceylon Observer*," *April 19th, 1888*.)

We call special attention to the following editorial note from the *Pharaceutical Journal* of London. We have for several years back with the ncurrence and approval of the highest authority in the island (the Director the Royal Botanic Gardens) adopted "coconut" in all our publications. The fficulty usually is to get people at home to aid in a change of the kind, but w that the step has been taken by so good an authority in England, we ast all writers, printers and publishers out here will follow suit and do at they can to make the convenient and indubitable form of "coconut" niversal. We would especially appeal to our contemporaries, to the Depart-ent of Public Instruction (and Agriculture), and last not least, to the overnment Printer to adopt what is so clearly and scientifically shown to be e correct form. If we could only convince "Mincing Lane" we should like xt to see "cacao" adopted for the produce as well as the tree; but this more difficult. "cocoa" as pronounced being a universal household as well "market" word for this food product and drink, in England. Still if "coco" kept f r the nut, there will be much less risk of "cocoa" beans, nibs, or ste being supposed to come from the palm tree. Here is the paragraph:—

COCO-NUT OR COCOA-NUT.—A discussion as to whether this should be elled c o-c-o or c o-c-o-a has recently been published. The palm yielding e coconut and the tree which furnishes the substance used as a bever-e and called cocoa, are known by botanists, and hence by pharmacists, have no connection. Nevertheless, many persons outside that intelligent rcle have an idea that both are products of the same tree, or are connected some way, and even botanists do not agree as to the correct spelling of e word coco in coconut. The evidence on the subject is briefly this:— early botanical works and books of travel coco-nuts are mentioned, the ord "coco" being derived from an Indian word coc or cocus, used to dicate the fruit of *Cocos nucifera*, or coconut of a fancied resemblance the base of the endocarp, with the three circular impressions, to the ce of a monkey whose conversational powers were limited to uttering sound like coco or cocus. According to another authority the word coco" in Portuguese means anything which frighten, the monkey-like pression on the endocarp being perhaps used for that purpose. Lin-us in forming the genus *Cocos* probably founded the name on these riations, and how it came to be known as cocoa (c-o-c-o-a) nut is not ite clear, but there is nothing to warrant such a method of spelling. ow that the leaves of *Erythroxylon Coca* are also articles of commerce d known as coco (c-o-c-a), it becomes a matter of much importance to scriminate carefully between the three substances of similar names but idely different nature.—*Pharmaceutical Journal*.

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All about 'coconut palm' (cocos Nucifera)

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